

17 Instruments and equipment requiring special processing

Key points

- ✦ Specialised equipment, such as flexible fiberoptic scopes, respiratory apparatus and diagnostic ultrasound probes may not withstand steam sterilisation, thermal disinfection or some chemical agents. Such equipment can also be complex and delicate, making it difficult to reprocess and sample microbiologically.
- ✦ Such equipment should only be used in health care establishments with proper reprocessing facilities, quality management systems to ensure full compliance with cleaning, disinfection and sterilisation protocols, and fully trained staff.
- ✦ Records must be kept to allow retrospective identification of instrument use for specific patients.
- ✦ Instruments that will be used in critical sites (penetration into sterile tissue) or semicritical sites (contact with mucosal or nonintact skin) should be sterilised with steam under pressure if they withstand heat.
- ✦ For instruments that will not withstand steam sterilisation, a low-temperature sterilisation system should be used if it is available (or a minimum of high-level chemical disinfection). For invasive procedures, all accessories must also be sterilised.
- ✦ Manufacturers' instructions regarding sterilisation and disinfection should be taken into account. However, some manufacturers currently specify chemical agents that are not registered for use as instrument-grade disinfectants. Within the next few years, medical device manufacturers will be obliged to provide reprocessing instructions.
- ✦ Flexible scopes should be reprocessed again on the day of use to kill environmental organisms that may have proliferated in any residual dampness (for duodenoscopes used for endoscopic retrograde cholangiopancreatography procedures, this reprocessing should be immediately before use).
- ✦ It is preferable to use a disposable breathing circuit during anaesthesia. If this is not possible, either a single-use filter must be used, or the breathing circuit (including the carbon dioxide absorber) must be discarded after each procedure. These items and other respiratory equipment are semicritical and the minimum reprocessing required is therefore high-level chemical or thermal disinfection.

Continued on next page

Key points (continued)

- ✚ Asthma spacers should be single-patient use only. In health care establishments, they should be reprocessed by high-level disinfection. In low-risk settings, such as home care and schools, they should be lower risk disinfected.
- ✚ Implantable items must be sterile at the time of use, and should not be 'flash' sterilised.

17.1 Endoscopes (general)

Detailed information on processing of endoscopes and accessories is given in the following publications:

- *Infection Control in Endoscopy, 4th edition* (Cowen et al 1999), published jointly by the Gastroenterological Society of Australia (GESA) and the Gastroenterological Nurses College of Australia (GENCA). A copy of these guidelines can be obtained from the GESA office (see **Appendix 7**); and
- AS/NZS 4187¹ on the care and handling of flexible and rigid endoscopes and accessory equipment.

17.1.1 Types of scopes

Scopes can be classified as rigid or flexible according to their construction. Specialised endoscopes are named in relation to the sites in the body that they are intended to visualise — for example, cystoscope (bladder), nephroscope (kidney), ureterscope (ureter), urethroscope (urethra), bronchoscope (bronchi), laryngoscope (larynx), otoscope (ear), arthroscope (joint), laparoscope (abdomen) and gastrointestinal endoscope (gastrointestinal tract).

Depending upon the procedure, gastrointestinal endoscopes may be further categorised as colonoscopes, gastroscopes, duodenoscopes, sigmoidoscopes and so on.

Duodenoscopes are used for endoscopic retrograde cholangiopancreatography, or ERCP, which is a tool used to assist in the diagnosis of liver, bile duct, gallbladder and pancreatic diseases. The flexible side-viewing duodenoscope used for ERCP is inserted into the small intestine via the mouth, oesophagus and stomach. A catheter is passed through the endoscope and manipulated into the bile and pancreatic ducts. Dye is injected into the ducts to enable X-ray imaging.

Some endoscopes, such as bronchoscopes and sigmoidoscopes, are available in both flexible and rigid constructions.

¹ AS/NZS 4187 (2003) *Cleaning, disinfecting and sterilizing reusable medical and surgical instruments and equipment, and maintenance of associated environments in health care facilities.*

Modern flexible fiberoptic scopes (including flexible bronchoscopes, colonoscopes, cystoscopes, duodenoscopes, gastroscopes and flexible sigmoidoscopes) are made from materials (eg plastics) that are unable to withstand temperatures above 60°C or many chemicals, which may lead to degradation of materials (eg lens cement). The endoscope is honeycombed with multiple small channels, some with blind endings, none of which can be adequately inspected following cleaning. The equipment is physically delicate, difficult to dry and difficult to sample microbiologically.

17.1.2 Quality control, traceability and surveillance

There is substantial evidence that endoscope and accessory reprocessing procedures are often not fully followed (Raymond et al 1990, Reynolds et al 1992, Collignon and Graham 1991, Bronowicki et al 1997). All centres that reprocess endoscopes and accessories should have clear and detailed quality management systems to ensure full compliance with all aspects of the cleaning and disinfection protocol. Clear, detailed and specific quality control processes for endoscope and accessory reprocessing are provided in *Infection Control in Endoscopy* (Cowen et al 1999). The reprocessing centre's data may be critical in a retrospective investigation about the possible transmission of infectious agents by endoscopy and in the interpretation of cultures from endoscopes and automatic processors. In general, the purposes of the quality control system are:

- to ensure that HCWs responsible for reprocessing endoscopes and accessories have a clear understanding of the important principles involved and fully understand each of the steps necessary in reprocessing;
- to record measurable parameters, such as disinfectant immersion time and disinfectant concentration; and
- to maintain accurate records of each reprocessing operation, allowing an effective 'lookback' study.

Periodical bacteriological surveillance is required as follows:

- *recommended* for gastroscopes and colonoscopes following reprocessing, as part of a quality assurance program;
- *essential* for duodenoscopes and bronchoscopes; and
- *essential* for inner surfaces of automated endoscope reprocessors (washer-disinfectors).

See AS/NZS 4187 and Cowen et al (1999) for further details.

Additional precautions are required for scopes that have been used on patients in the risk groups for CJD (**Section 31.9**). If a scope has been reused after use on a patient who is subsequently diagnosed with CJD, a lookback investigation may be necessary (see **Section 31.16**).

Centres that reprocess endoscopes and accessories should have clear and detailed quality management systems.

▷ For further information about instruments that cannot be adequately reprocessed in respect of CJD infectious agents, see **Section 31.14**.

17.2 Endoscopes (gastrointestinal tract)

17.2.1 Risk factors

Clinical infections associated with the use of endoscopes may occur because infectious agents are transmitted from one patient to another during examination via the endoscope or its accessory equipment. Scopes can also be contaminated from the general hospital environment, from the water supply or from disinfecting machines (Axon 1991). Infectious agents introduced into sterile (critical) sites in the ducts in the organs under investigation during ERCP pose a higher risk of infection than endoscopic procedures that involve semicritical or noncritical sites.

The important risk factors are:

- the number and type of infectious agents present on or in the scope, its water-feed system and accessories;
- the particular type of procedure to be undertaken and whether tissue penetration or disruption occurs (for example, in procedures such as dilatation and polypectomy); and
- patient factors, including immune status, endovascular integrity, indwelling foreign material such as prostheses, and the presence of infective foci.

Flexible fibreoptic endoscopes are made from materials that cannot be steam sterilised or withstand many chemicals (see **Section 17.1.1**). However, there have not been many reported clinical infections due to endoscopic procedures, despite the difficulties associated with endoscopy. ERCP is the only endoscopic procedure that has been associated with a consistently significant rate of procedure-induced infection (Cowen et al 1999).

Infectious agents that can contaminate endoscopes

The following microorganisms can contaminate endoscopes:

- Bacteria that are resident in the gastrointestinal tract, such as salmonella, shigella, campylobacter and related species (O'Connor et al 1982, Dwyer et al 1987), *Serratia marcescens* (Webb and Vall-Spinosa 1975, Vandenbroucke-Grauls et al 1993), *Helicobacter pylori* (Gledhill et al 1985, Langenberg et al 1990) and *Clostridium difficile* (Patterson et al 1984, Hughes et al 1986).
- Other bacteria (usually derived from the environment), such as pseudomonas or similar bacteria, including *Proteus* spp). These bacteria, which are responsible for most reported endoscopy infections (Greene 1974, Bianco et al 1990) are resident hospital pathogens that colonise almost any damp surface, including channels within the endoscope itself, although in practice this has only been a problem for ERCP and endoscopy in severely immunocompromised patients where tissue disruption has occurred.

- Viruses such as human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV). When HIV is protected within a dried protein coagulum, some chemical disinfectants, such as glutaraldehyde, may fail to inactivate the virus (Hanson et al 1989a). This emphasises the need to ensure that all traces of blood and proteinaceous material are removed by scrupulous manual cleaning without delay after the procedure is completed (Hanson et al 1989b, 1990). Despite the high infectivity of HBV, there are few well-documented cases of transmission by endoscopy (Ferrari et al 1991). With HCV, however, there are now many documented cases (Crenn et al 1988, Kim et al 1996, Bronowicki et al 1997).
- Other infectious agents, such as fungi, protozoa and other bacteria and viruses, could potentially be transmitted by endoscopy. In practice, however, infectious agents such as cryptosporidia usually pose a significant threat only to immunocompromised patients.
- The infectious agent causing CJD presents a theoretical risk for all types of endoscopy (see **Section 17.2.4**).

Water-feed systems and rinse water

Hospital tap water may be contaminated with a variety of infectious agents, including pseudomonads and mycobacteria. This can pose a risk to patients if sterile cavities are entered, if there is extensive disruption of tissue or if the patient is immunocompromised. The following rinsing procedures are therefore recommended:

- After mechanical cleaning and disinfection, gastrointestinal endoscopes should be rinsed with filtered potable water of low mineral content.
- Duodenoscopes and endoscopes used in ERCP should be rinsed in water that is filtered through 0.2-µm filters, or with sterile bottled water. A coarse prefilter may be used to prolong the life of the 0.2-µm filter. (Note: bottled supermarket water is not sterile and is not suitable for this purpose.)

Patients with increased susceptibility to infection

A variety of clinical circumstances may increase the danger of infection associated with endoscopy, including:

- compromised immune status, such as HIV infection, neoplastic disease, cancer therapy, transplantation and advanced systemic disease (eg liver or renal failure);
- procedurally induced tissue damage such as oesophageal dilation, polypectomy and sphincterotomy at ERCP;
- intrinsic sources of infection such as diverticulitis or abscess, cholangitis or infected pancreatic pseudocyst; and
- increased risk of bacterial lodgment, such as cardiac valve prosthesis, rheumatic heart disease, or indwelling devices such as Hickman catheters; septic arthritis of prosthetic joints has been reported only rarely after endoscopic procedures.

17.2.2 Level of reprocessing required

The bile and pancreatic ducts are sterile (critical) sites and anything that enters these sites, such as accessories or catheters used within ERCP duodenoscopes, must be sterile.

As flexible fiberoptic duodenoscopes do not withstand steam sterilisation, low-temperature chemical sterilisation should be used, if available, to sterilise them. If this is not available, high-level disinfection is the *minimum* level of reprocessing required for the duodenoscope itself. Accessories and catheters must be sterile.

Other endoscopes are used in mucosal (semicritical) sites, and the *minimum* level of reprocessing for endoscopes that cannot withstand sterilisation is therefore high-level disinfection.

Endoscope accessories designed for reuse, and other items that penetrate tissue (eg biopsy forceps), or are associated with tissue disruption or introduction of devices into duct systems, must be sterile at the time of use. Where this process cannot be achieved, sterile single-use only accessories must be used. These single-use items cannot be reused.

IMPORTANT



IMPORTANT NOTE

Endoscopes and sheaths

Sheaths that cover endoscopes have recently become available to help reduce endoscope contamination. Use of these sheaths does not remove the necessity for correct cleaning and reprocessing of endoscopes between patient uses. Due to the potential for sheaths to be torn, to break or to have holes that are invisible to the naked eye, all endoscopes must be reprocessed according to the recommendations below regardless of whether sheaths are used.

17.2.3 Reprocessing methods

The reprocessing of flexible endoscopes is a difficult and complex task. Therefore:

- endoscopy should be undertaken only in centres that have adequate facilities for cleaning and disinfection; and
- only fully trained HCWs should perform the critical task of processing endoscopic equipment and accessories.

Full explanation and details of the cleaning and disinfecting processes can be found in the GESA/GENCA guidelines (Cowen et al 1999), AS/NZS 4187 and on the Queensland Health internet site.²

² <http://www.health.qld.gov.au/EndoscopeReprocessing>

Manual processing

Standard precautions should be used for the manual cleaning of endoscopes and accessories. Appropriate personal protective equipment (gloves, impervious gowns, plastic aprons, splash-resistant masks, safety eyewear and face protection) should be worn.

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For duodenoscopes, inadequate cleaning and disinfection of the forceps-raising channel, and contamination of the water-feed system, has been linked to infection in ERCP procedures (Cowen et al 1999). The water bottle and connecting tube must be sterilised and changed between each patient use. Sterile bottled or 0.2-µm filtered water must be used. (Note: bottled supermarket water is not sterile and is not suitable for this purpose.)

Cleaning

- The most important step in the process of endoscope reprocessing is scrupulous manual cleaning before disinfection.
- Endoscopes and accessories must be immersed in an anionic detergent solution, at ambient temperature, immediately after removal from the patient, and cleaned and reprocessed as soon as possible.
- Equipment must be fully disassembled before reprocessing. All endoscopes are supplied with appropriate cleaning adaptors and accessories. Manufacturers' instructions must be followed.
- Cleaning should be carried out according to the detailed guidelines in *Infection Control in Endoscopy* (Cowen et al 1999). The fine channels within endoscopes are difficult to clean, and a variety of internal disruptions, including surface abrasions, splitting and cracking of channels and partial joint springing of accessories, may impair the cleaning process.

Disinfection and sterilisation

- For duodenoscopes used for ERCP (which are in contact with critical sites), a low-temperature sterilisation process, such as hydrogen peroxide plasma (HPP) or peracetic acid (PAA) sterilisation in an automated microprocessor-controlled closed system, is preferred, if this equipment is available and the scopes can tolerate this treatment. The key principle is that instruments that enter sterile tissues must be sterile.
- High-level chemical disinfection is the *minimum* reprocessing standard for all endoscopes because the instruments are in contact with the mucosal surface (semicritical sites). This may be achieved, for example, by complete immersion in a solution of a chemical disinfectant, registered by the Therapeutic Goods Administration (TGA) as a high-level instrument-grade disinfectant solution. Further details are given in **Section 16** of these guidelines.

High-level chemical disinfection is the *minimum* reprocessing standard for all endoscopes.

- Following low-temperature sterilisation or high-level disinfection, endoscopes must be rinsed in an acceptable grade of water (see **Section 17.2.1**), purged with alcohol and thoroughly air-dried before storage on hangers designed specifically for that purpose. A minimum of 150 mL of water should be flushed through each channel of the endoscope to remove all traces of disinfectant residue. A greater volume may be required according to the length of the instrument. Because the instrument is used in sterile (critical) sites, each channel of a duodenoscope must be rinsed with sterile bottled or 0.2-µm filtered water (not bottled supermarket water) to avoid contamination with environmental organisms such as pseudomonads and mycobacteria.
- Sterile water must be used in endoscope water-feed systems.
- All endoscopes should be leak tested after immersion and before cleaning and disinfection or sterilisation, to identify problems that may result in damage to the scope during reprocessing.
- After effective cleaning and disinfection, the instrument must be dried before storage to prevent environmental organisms (eg pseudomonads) from multiplying in the channels before the endoscope is reused. However, as any residual dampness may allow proliferation of organisms, scopes should be reprocessed again after storage (see **Reprocessing again before use**, below).

With rapidly evolving technologies and dynamic product development in the area of infection control, instruments that can be easily dismantled and steam sterilised may become widely available in the future, bringing major advantages.

Automated reprocessing

Washer–disinfectors

Automated endoscope reprocessors (washer–disinfectors) may be used effectively in the reprocessing of endoscopes. It is critical that HCWs using automated washer–disinfectors understand the principles of machine operation and the limitations of each machine (eg some do not have flow alarms). Currently, it is necessary to brush the internal channels of the endoscope before placing it in the washer–disinfector. However, some innovative automated washer–disinfectors now available in Australia include cleaning mechanisms in their cycles (see **Section 16.3.7**).

Further details of automated endoscope reprocessors can be found in *Infection Control in Endoscopy* (Cowen et al 1999).

Automated low-temperature chemical sterilisation processing

Automated PAA- and HPP-based chemical processing systems offer highly effective systems of endoscope disinfection and sterilisation, provided the chemicals are compatible with the endoscopes (see **Section 16.5.6**). Use of these systems does not preclude the need to preclean instruments and

equipment. Where automated systems are used, the system must be regularly monitored for efficacy and performance in accordance with the manufacturer's technical instructions. Occupational health and safety issues involved for the handling of the chemicals should be considered (see **Section 7.4**).

Reprocessing again before use

There is a risk that residual dampness will allow remaining organisms to proliferate, so all scopes that have not been terminally sterilised (ie packaged) must be reprocessed (preferably sterilisation or a minimum of high-level disinfection) after patient use and then a second time on the day of use. Duodenoscopes used for ERCP must be reprocessed as close as possible to the time of the procedure (Cowen et al 1999) because this is a high-risk procedure and the possible recontamination time should be kept to a minimum.

17.2.4 Prevention of CJD transmission

Endoscopes cannot be adequately processed for CJD infectious agents. If a scope is used in a patient in a risk group for CJD (**Section 31.9**), it should be handled as described in **Section 31.14**. In CJD risk patients, alternative options to endoscopic diagnosis should be sought without prejudice to patient care.

If a scope has been reused after use on a patient who is subsequently diagnosed with CJD, a lookback investigation may be necessary to identify at-risk patients (see **Section 31.16**).

If a scope has been reused after use on a patient who is subsequently diagnosed with CJD, a lookback investigation may be necessary.

17.3 Bronchoscopes

Flexible or rigid bronchoscopes may be used for direct visualisation of the tracheobronchial tree. Flexible fibreoptic bronchoscopes are commonly used in diagnostic procedures, with the patient under sedation. Rigid bronchoscopes are usually used in operating room situations, with the patient under general anaesthetic.

17.3.1 Risk factors

When patients with active tuberculosis have a bronchoscopy, there is a risk of transmission of *Mycobacterium tuberculosis* (see **Sections 11.5.5** and **29.8**). When this has occurred, it appears to have been due mainly to inadequate cleaning before disinfection or sterilisation (Wheeler et al 1989, Bryce et al 1993, Fraser et al 1992, Reeves and Brown 1995).

Atypical mycobacteria, which are frequently present in tap water, can contribute to biofilm formation in older models of automated washer-disinfectors without self-disinfection cycles (Middleton 1997). The organisms may be transmitted to bronchoscopes during reprocessing and then to the patient during bronchoscopy. This can lead to misdiagnosis and inappropriate

treatment of tuberculosis because of the appearance of acid-fast stained bacilli in cultures or on direct microscopy. In addition, immunocompromised patients are at a higher risk of succumbing to infections caused by atypical mycobacteria and other opportunistic respiratory pathogens.

The infectious agent causing CJD presents a theoretical risk for contamination of bronchoscopes (see **Section 17.3.4**).

17.3.2 Level of processing required

Because the lower airways are usually sterile (critical site), sterilisation is required if available. High-level disinfection is the *minimum* level of reprocessing required.

When an invasive procedure (eg biopsy) is planned, all accessories must also be sterilised before the procedure.

17.3.3 Reprocessing procedures

Rigid bronchoscopes should be sterilised by steam sterilisation.

Flexible bronchoscopes should be reprocessed with a low-temperature sterilisation system, such as PAA or HPP, if it is available and provided the scopes are compatible with the process.

For high-level disinfection, after appropriate cleaning, bronchoscopes should be soaked in a high-level instrument-grade disinfectant for the time stated on the manufacturer's label to eradicate *Mycobacterium tuberculosis*. After disinfection, the instrument and its channels should be immersed and rinsed thoroughly with sterile water, rinsed with 70% alcohol and dried with compressed air.

Disposable covers are recommended for use on bronchoscopes and accessories (eg detachable camera heads), when available.

Bronchoscopes that have not been terminally sterilised (ie packaged) should be reprocessed again on the day of use, as for endoscopes (see **Section 17.2.3**).

17.3.4 Prevention of CJD transmission

Bronchoscopes cannot be adequately processed for CJD infectious agents. If a scope is used in a patient in a risk group for CJD, it should be handled as described in **Section 31.14**.

If a scope has been reused after use on a patient who is subsequently diagnosed with CJD, a lookback investigation may be necessary to identify at-risk patients (see **Section 31.16**).

17.4 Other fiberoptic scopes and associated equipment

17.4.1 Types of instruments

Instruments used in sterile sites

Other fiberoptic scopes that are used in sterile (critical) sites include laparoscopes, cystoscopes, thoroscopes, hysteroscopes, ureterscopes and arthroscopes. Ancillary equipment for these procedures includes cameras, biopsy forceps and light leads.

Instruments used in nonsterile sites

Other fiberoptic scopes used in mucosal (semicritical) sites include sinoscopes, laryngoscopes, oesophagoscopes and urethrascopes. Ancillary equipment is the same as that for sterile sites.

17.4.2 Risk factors

Items that breach the protective integrity of the skin and mucous membranes provide infectious agents with direct access to sterile tissue sites.

The infectious agent for CJD presents a theoretical risk in the use of fiberoptic scopes (see **Section 17.4.5**).

17.4.3 Level of processing required

For use in sterile (critical) sites, fiberoptic scopes and their associated auxiliary equipment must be sterile at the time of use, as indicated in **Table 16.1**.

Where access for cleaning is difficult, or the invasive accessories are heat sensitive, the use of sterile single-use accessories is preferred.

For use in mucosal (semicritical) sites, fiberoptic scopes and their associated auxiliary equipment should be sterile at the time of use or, as a minimum, high-level disinfected, as indicated in **Table 16.1**.

17.4.4 Reprocessing procedures

Equipment must be thoroughly cleaned and dried before sterilisation.

Sterilisation should be by a low-temperature sterilisation system such as PAA or HPP, if it is available, or by high-level disinfection. The reprocessing procedures should be the same as those described for other endoscopes and bronchoscopes (see **Sections 17.2** and **17.3**).

Associated invasive accessories should be packaged for steam sterilisation or used immediately following their removal from a low-temperature sterilisation process.

Fibreoptic scopes cannot be adequately processed for CJD infectious agents.

All fibreoptic scopes that have not been terminally sterilised (ie packaged) should be reprocessed again on the day of use, as for endoscopes (see **Section 17.2.3**).

17.4.5 Prevention of CJD transmission

Fibreoptic scopes cannot be adequately processed for CJD infectious agents. If a scope is used in a patient in a risk group for CJD, it should be handled as described in **Section 31.14**. If a scope has been reused after use on a patient who is subsequently diagnosed with CJD, a lookback investigation may be necessary to identify at-risk patients (see **Section 31.16**).

17.5 Respiratory and anaesthetic apparatus

17.5.1 Types of equipment and risk factors

Items of equipment that are introduced into the patient's airway can provide direct access for potential pathogens. There is a potential for patient-to-patient transmission of infection (such as tuberculosis).

Aerosol transmission of infectious agents has been documented via respiratory equipment, including spirometry or pulmonary function testing apparatus (Hazeleus et al 1991) and anaesthetic apparatus (Joseph 1952). Moist gases can transport infectious agents along breathing circuits and nebulisers can harbour infectious agents. Transmission of infection may also occur through resuscitation and analgesic respiratory equipment used in hospitals (operating rooms, intensive care units, accident and emergency departments, and delivery suites), medical and dental practices, ambulances and first aid areas.

17.5.2 Level of processing required

Respiratory, anaesthetic, resuscitation and similar apparatus and ventilators used in anaesthesia and in intensive care units are generally classed for use in mucosal (semicritical) sites and therefore should be sterilised wherever possible. If items cannot withstand sterilisation, they must be exposed to at least thermal disinfection or high-level chemical disinfection (see **Table 16.1**).

While there may be an additional cost involved in sterilising semicritical components of the breathing system, using disposable circuitry and incorporating filters, this should be balanced against the reduced risk of transmission of infection.

17.5.3 Reprocessing procedures

Items of equipment that may be contaminated by patient-to-patient transmission of infections such as tuberculosis should be single use. Reuseable equipment should be capable of at least thermal disinfection or high-level chemical disinfection (see **Table 16.1**).

It is preferable that all patient circuits contain a filter capable of removing particulates and aerosols from the gas pathway. The common position for this filter is in the reciprocating gas flow immediately adjacent to the patient. If the filter is not placed in this position but is positioned on the expiratory limb between the expiratory hose and the absorber head, a second protective filter must be placed on the inspiratory limb because the gas flow is not totally unidirectional.

If a filter is used, all items between the patient and the filter, including the filter, must be discarded after a single patient use. Items retrieved from the patient should be drained and dried of condensed moisture. The filter should be visually inspected to ensure that there is no moisture that could compromise the filter's integrity.

If a filter is used, all items between the patient and the filter, including the filter, must be discarded after a single patient use.

If no filter is used, the disinfection must include all of the breathing circuit (ie the mask or tube and connections, the inspiratory and expiratory hoses, the inspiratory and expiratory connections, the carbon dioxide absorber and one-way valves, the reservoir hose and reservoir bag and any monitoring devices within the breathing circuit exposed to the respiratory gases). Components that cannot be disinfected should be discarded and replaced.

If lubricant is used on tubes for insertion into the patient's airway, it should be obtained from single-use sachets that are then discarded. Tracheal tubes, laryngeal masks, pharyngeal airways, suckers and equipment used to introduce these items, such as laryngoscope blades and introducers, must be cleaned, sterilised and dried before reuse, or discarded after a single use. Demand and inhalation valves used in resuscitation and analgesic equipment should be dismantled, cleaned, sterilised and dried and then checked for performance after each patient use. It is very important that these items of equipment are dry before use.

Further information may be obtained from the Australian and New Zealand College of Anaesthetists, the Australian Society of Anaesthetists, and the Thoracic Society of Australia and New Zealand (see **Appendix 7**), and AS/NZS 4187.

17.5.4 Respiratory function laboratories

All items must be cleaned and reprocessed according to manufacturers' instructions, because heat, chemicals and gases may damage some equipment. After cleaning and disinfection, it is essential that all items are rinsed with sterile water and air-dried before use. Reprocessed equipment should be stored in covered containers.

Barrier filters are single-use items and may be used to protect all equipment that can be contaminated with patient expirates, where the equipment is not disinfected or replaced between patients. There is evidence that the use of barrier filters will reduce the risk of transmission of infection (Side et al 1999).

It is important to be aware that the use of filters does not preclude the need for cleaning. Mouthpieces, nose clips, tubing and other equipment on the patient side of a filter should be replaced with clean, sterilised or high-level disinfected components between patients.

When choosing barrier filters, it is important to verify the resistance and efficacy of filtration at flow rates up to at least 14 L/second. The resistance of the breathing circuit, including the filter, should be < 2.5 cm water per litre per second at flow rates up to 14 L/second (American Thoracic Society standard). The filter should have a low effective deadspace (50 mL).

In respiratory function laboratories, equipment considered to be semicritical includes reusable mouthpieces, reusable nose clips, one-way breathing valves, pneumotachograph screens, turbine assemblies, mouth shutters and specialised nebulisers used for bronchial challenge tests. These items must be disassembled and thoroughly cleaned before reprocessing, using either sterilisation or high-level disinfection. Gloves should be worn when handling equipment contaminated with saliva (standard precaution). Equipment distal to a barrier filter or one-way breathing valves should be cleaned at least once daily to remove particulate matter and moisture (Crockett and Grimmond 1993).

The outside surface of tubing that is in direct contact with or handled by patients should be cleaned between patients. The environment of the laboratory should be maintained by regular cleaning with detergent and be kept dust free.

Routine handwashing should be performed before and after each patient contact.

Items labelled as 'single patient use', including peak flow meters and nebulisers used for bronchodilators and oesophageal balloons, must not be reprocessed.

The effectiveness of infection control procedures can be independently verified by culturing swabs taken from respiratory equipment (internal surfaces of spirometers and the proximal side of flow spirometers). While some laboratories do this regularly, it is sufficient to carry out random spot checks.

17.5.5 Items and equipment for use in noncritical sites

Noncritical sites are defined as intact skin; they do not include intact mucosal sites, which are considered to be semicritical sites. Items or equipment for use in noncritical sites (eg anaesthetic armboards and stethoscopes), or which do not come into direct contact with patients (eg the surface of the anaesthetic machine or resuscitator), should be cleaned after each use (see **Table 16.1**).

Anaesthetic and respiratory washer–disinfectors that comply with AS 2945³ can be used to process anaesthetic and respiratory equipment that is not required to be sterile at the time of use (see AS/NZS 4187 and AS/NZS 4815 for details).

17.6 Asthma spacers used with metered-dose inhalers (MDIs)

17.6.1 Risk factors

An asthma spacer should be used with a metered-dose inhaler (MDI) in the following instances:

- by all adults who have poor coordination when using an MDI;
- by children of all ages (children under four years can use an MDI and a small-volume valved spacer with a face mask);
- during acute attacks; and
- by patients using inhaled steroids by MDI, particularly at higher doses (National Asthma Council 2002).

IMPORTANT NOTE

Spacer devices used with MDIs

Although there have been no instances reported, deep inhalation of medication from spacer devices used with MDIs could result in cross-infection. Respiratory devices are considered semicritical and should be reprocessed appropriately (see **Section 16.2.2**). To minimise the risk of cross-infection from waterborne organisms such as *Legionella pneumophila* (CDC 1997a) following the cleaning process, care should be taken to drain the spacer and ensure no residual water is left in the spacer chamber.

IMPORTANT



17.6.2 Reprocessing standards for health care settings

Hands should be thoroughly washed and dried before handling asthma spacers.

Spacers should be for the exclusive use of a single individual. Health care establishments should maintain a store of spacers to ensure that new spacers are always available when required. If multiuse is necessary (in an emergency) the spacer should be reprocessed using thermal disinfection (see **Section 16.4.2**).

If multiuse is necessary (in an emergency) the spacer should be reprocessed using thermal disinfection.

³ AS 2945 (1998) *Batch-type washer/disinfectors for health care facilities*.

Spacers should be washed in a hot water and detergent solution before steam sterilisation and pasteurisation. The spacer should be dipped in a diluted detergent solution and left to drain (without rinsing) until it is dry, ensuring that no residual water is left in the spacer. If steam sterilisation is not available, spacers should be pasteurised. If pasteurisation is not possible, see **Section 17.6.3**.

IMPORTANT**IMPORTANT NOTE****Drying spacers**

Do not use a cloth to dry the spacer. This could produce an electrostatic charge that may cause drug particles to adhere to the walls of the spacer, resulting in less deposition in the lungs.

17.6.3 Reprocessing procedures in a community setting**Home use**

A spacer is a personal item and should be for the exclusive use of an individual and not shared with anyone else. Hands should be washed and dried before using a spacer. Every 1–2 weeks, spacers should be washed in a hot water and detergent solution and left to drain without rinsing, ensuring that no residual water is left in the spacer.

First aid kits in community settings, including schools

First aid kits should contain a reliever MDI and matching spacer device. A spacer should be used to administer asthma medication to a child. Normally, a person should carry their own reliever MDI and spacer. In an emergency, an MDI and spacer from a first aid kit may be used; they must be reprocessed before reuse, as follows.

Spacers should be washed in a hot water and detergent solution and left to drain (without rinsing) until dry. When the spacer is dry, the mouthpiece should be wiped thoroughly with a 70% alcohol solution (to prevent electrostatic charge production). A cloth should not be used to dry the spacer. This could produce an electrostatic charge that may cause drug particles to adhere to the walls of the spacer, preventing the correct dose being delivered to the lungs.

In schools or care settings, each child for whom asthma medication has been prescribed should have their own spacer and a supply of medication, clearly labelled with the name of the child and next-of-kin contact details. Parents or carers have a responsibility to convey clear instructions from the medical practitioner to the school or care setting about the child's medication requirements.

17.7 Resuscitation manikin facepieces and accessories

When resuscitation manikins are used for training purposes, the parts of the manikin that come into contact with oral secretions should be changed or reprocessed between use to avoid transmitting infections between trainees (see **Section 17.7.2**).

17.7.1 Risk factors

The mucous membranes of the mouth and saliva may be the source of respiratory pathogens such as influenza virus, HBV and streptococci. These pathogens may colonise manikin facepieces after use by a first aid trainee and be transferred to other users if cleaning and disinfection of the facepiece between users is inadequate.

17.7.2 Reprocessing procedures

Manikin facepieces and accessories are used in first aid training. They can be thermally disinfected but this may not be an option in field training situations (eg sportsgrounds, beaches). Such facepieces should therefore be thoroughly cleaned with warm water and detergent, rinsed and dried before disinfection with an appropriate disinfectant. The pieces must be dry before immersion in disinfectant to ensure that the disinfectant solution is not diluted; dilution would result in inadequate disinfection over the contact period. Before use, it is essential to rinse the item free of residual disinfectant with water.

The Australian Resuscitation Council and first aid training providers should be contacted for further advice (see **Appendix 7**).

17.8 Diagnostic ultrasound transducers

17.8.1 Risk factors

Diagnostic ultrasound transducers are used in many sterile (critical) situations, including renal, hepatic and hepatobiliary studies, for the review of vascular surgical repairs, and for some endobronchial and gynaecological operations.

They are also used in mucous membrane (semicritical) sites (transvaginal, transrectal and transoesophageal ultrasound).

Potential sources of infection associated with vaginal ultrasound include infectious agents transmitted by blood and genital secretions, such as HIV, HBV, HCV, cytomegalovirus, *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, *Trichomonas vaginalis* and human papilloma virus. Other infectious agents are associated with rectal or oesophageal ultrasound.

Abdominal ultrasound examination is generally considered to be a low-risk procedure where it involves contact with intact skin (noncritical site). However, there is a potential for transmission of bacteria such as *Staphylococcus aureus*, particularly in a patient with an abdominal wound.

The infectious agent for CJD presents a theoretical risk for the use of ultrasound transducers in the brain or spinal cord (see **Section 17.8.3**).

17.8.2 Level of reprocessing required

The external surfaces or covers of diagnostic ultrasound transducers that are to be used in sterile (critical) sites must be sterile. Wherever possible, transducers that are capable of being sterilised should be used. Low-temperature chemical sterilising technologies suitable for processing heat-sensitive items include the PAA and HPP sterilisation systems (see **Section 16.5.6**). However, some ultrasound transducers may be made of materials that do not withstand exposure to these chemical agents.

▷ Further information on high-level disinfectants is given in **Sections 7.2** and **16.4.3**.

Instruments that contact nonsterile mucous membranes (semicritical sites) usually require either sterilisation (if possible) or high-level disinfection with a compatible instrument-grade disinfectant, as a minimum, in accordance with manufacturers' instructions. Unless sodium hypochlorite is labelled as a high-level instrument-grade disinfectant, it may not be suitable for reprocessing these instruments.

Instruments that are only in contact with intact skin (noncritical sites) should be cleaned in accordance with the manufacturer's instructions where available.

17.8.3 Prevention of CJD transmission

Ultrasound transducers cannot be adequately processed for CJD infectious agents. Ultrasound transducers applied to the brain or spinal cord of a patient in a risk group for CJD should be destroyed or quarantined as described in **Section 31.12**. If the transducer has been applied to low-infectivity tissue of a patient in a risk group for CJD, it should be handled as described in **Section 31.14**.

If an ultrasound transducer has been reused after use on a patient who is subsequently diagnosed with CJD, a lookback investigation may be necessary (see **Section 31.16**).

17.8.4 Precautions during procedures

Standard precautions (see **Section 2.2**) should always apply where there is a potential for contact with blood or body substances, nonintact skin or mucous membranes, and should therefore be used with transvaginal and transrectal ultrasound procedures.

For transoesophageal ultrasound, disposable sheaths may be available, but care should be taken to ensure that they do not detach during the procedure. Less effective alternative covers include condoms and gloves.

Probes for transvaginal and transrectal ultrasound procedures must be sheathed in a disposable impermeable cover that is changed for each patient. Care should be taken to ensure that the sheath is not overstretched (overstretching may result in perforation) and that it does not detach during the procedure. It is essential that, for each new procedure, the cover is either sterile or appropriate for use in a semicritical site. The probe itself should be reprocessed according to the manufacturer's instructions where available.

The disposable cover should be thick enough to resist tearing or perforation during use. The preferred option is water-repellent polyethylene surgical drape sheeting (at least 38 µm thick), which can be cut to adequately cover the transducer. Its thickness makes it a more reliable barrier to water than commercially available plastic wraps. Less effective alternative covers include condoms and gloves (Storment et al 1997). A material other than latex should be used for patients who are known to be latex-sensitive (Douglas et al 1997).

At the end of each procedure, the cover should be removed and discarded, taking care not to contaminate the surface of the instrument. Surgical drape is also preferred for this reason. After removing all the gel from the transducer, the instrument should be cleaned (AIUM 1995) with warm water and a neutral detergent in accordance with the manufacturer's instructions. A small brush may be used for crevices or angles on the instrument, depending on its design.

Although use of a disposable cover reduces the level of risk of transmission of infection or contamination, covers can be perforated or contain small, unrecognised defects. For this reason, after thorough cleaning in warm water and detergent, the transducer should be soaked in a high-level instrument-grade disinfectant recommended by the transducer manufacturer for the time required for high-level disinfection. After disinfection, the instrument should be thoroughly rinsed and dried before reuse with a new cover.

For abdominal ultrasound in cases where there is an open wound, a disposable cover should also be used. After the procedure, the cover should be discarded and the probe reprocessed.

Gel used in ultrasound procedures can also be a potential source of infection; care should be taken to ensure there is no risk of contamination of the gel used during the procedure (Weist et al 2000). For surgical use, gel should be sterile. Gel containers should not be refilled or reused, because they may have become contaminated.

Gel used in ultrasound procedures can also be a potential source of infection.

Further information on ultrasound devices can be found in *Guidelines for Disinfection of Transvaginal Transducers* (ASUM 1999), which can be obtained from the Australasian Society for Ultrasound in Medicine (see **Appendix 7**). However, these guidelines should be read in conjunction with AS/NZS 4187 (and also see **Section 17.8.2** concerning the use of high-level instrument-grade disinfectants for instruments to be used in semicritical sites).

17.9 Thermometers

Glass thermometers are reusable, but they should be used on one patient only, for the duration of that patient’s stay in the health care establishment, and then be cleaned and disinfected before use on other patients. Thermometers should be cleaned with warm water and detergent, then disinfected with alcohol (an alcohol wipe is suitable and soaking is not necessary) and stored dry. For home visits, thermometers may be transported in a carry case — this should either be disposable or be cleaned and disinfected together with the thermometer before reuse.

The use of disposable covers for thermometers used in body cavities, including the ear, mouth, vagina or rectum, should be encouraged. The thermometer should be wiped over after each use. However, daily cleaning and disinfection, as above, is still required, because covers may be defective or become damaged during use. Thermometers used in sterile body cavities must be sterile.

DISCUSSION POINT



Reusable thermometers

Glass thermometers containing mercury are not recommended, because of the hazards associated with breakage. Thermometers that do not contain mercury are preferred.

If tympanic thermometers are used, a new probe cover should be used for each temperature reading, as small specks of dust or debris on the cover may make readings inaccurate. Manufacturers’ instructions for calibration and storing of tympanic thermometers must be followed.

Infectious agents may survive immersion in liquid nitrogen.

17.10 Cryotherapy

Care should be taken to ensure that liquid nitrogen canisters do not become contaminated during cryotherapy procedures, because viruses and bacteria may survive immersion in liquid nitrogen. Where liquid nitrogen is used for routine removal of warts, sufficient liquid nitrogen should be decanted into a styrofoam cup and a fresh cotton-tipped applicator should be used for each application. Any residual or remaining contents of the cup should be discarded. Similar precautions should be taken with carbon dioxide and other cryotherapy systems used in the treatment of skin conditions (see **Section 34.2.1**).

17.11 Ophthalmic and optometry equipment

The cornea and conjunctiva are regarded as semicritical sites. Contact lenses should not be shared. Diagnostic contact lenses should be reprocessed in accordance with the manufacturer's recommendations. Internal components of the eye are sterile. Instruments that enter the eye or contact components that enter the eye (eg phacoemulsification handpieces) should be reprocessed as sterile instruments.

Because of the known infectivity of CJD in the eye (see **Table 31.1**), special care should be taken when patients in either higher- or lower-risk categories for CJD (see **Section 31.9**) are undergoing ophthalmic or optometric procedures. Instruments that come into contact with the posterior segment of the eye (retina, optic nerve) in these patients should be either destroyed or reprocessed and quarantined in accordance with the guidelines in **Tables 31.4** and **31.9**.

17.12 Implantable items

Implantable items must be sterile at the time of use, and should not be 'flash' sterilised (AS/NZS 4187). Explanted devices should not be reimplanted.

Explanted devices should not be reimplanted.

Some manufacturers have TGA approval to allow reprocessing of implantable items (see **Section 16.2.4**) that have been opened but have not had contact with tissue (that is, have been opened but not used). Manufacturers' instructions for reprocessing must be followed explicitly in these instances.

17.13 Instruments labelled 'single-use device'

Instruments labelled 'single-use device' should be discarded after use, in accordance with manufacturers' recommendations and consistent with their TGA approval status.

Establishments may wish to consider reprocessing some expensive instruments labelled 'single-use device' (eg cardiac solid electrodes).

The TGA's advice about reprocessing 'single-use' instruments is as follows:

Devices listed on the Australian Register of Therapeutic Goods (ARTG) as 'single use' should be used only once. In July 2001, the Australian Health Ministers' Advisory Council (AHMAC) agreed that any reprocessing of single use devices for reuse is a manufacturing activity and that this should be regulated by the TGA. AHMAC also agreed that the regulation of the re-manufacture of single use devices for reuse should meet the same regulatory requirements and standards as apply to the original manufacturer. Any reprocessing would therefore only occur in a Good Manufacturing Practices (GMP) licensed facility that includes a monitoring system

to ensure microbiological safety and product integrity. The TGA is developing a regulatory proposal for reprocessing of single use devices, but is not in the position to license reprocessing facilities until this regulatory proposal has been fully considered by all relevant stakeholders and finalised.

This option may be used only for instruments that are capable of withstanding reprocessing that involves additional heat or chemical sterilisation methods without compromising product safety and integrity.

18 Environmental cleaning and spills management

Key points

- ✦ Routine cleaning of work areas is important because deposits of dust, soil and microbes on surfaces can transmit infection.
- ✦ Health care establishments must have management systems for dealing with blood and body substance spills. Protocols for spills management should be included in procedures manuals and emphasised in ongoing education and training programs.
- ✦ The basic principles of spills management are as follows:
 - standard precautions apply where there is a risk of contact with blood or body substances;
 - spills should be cleaned up before the area is disinfected; and
 - aerosolisation of spilled material should be avoided.
- ✦ Standard cleaning equipment (including solutions, water, buckets, cleaning cloths and mop heads) should be readily available for spills management and stored in a place known to all health care workers.
- ✦ All cleaning items should be changed routinely. They should also be changed immediately following the cleaning of blood or body substance spills.
- ✦ Contaminated areas such as operating rooms or isolation rooms must be cleaned after each session.

18.1 Routine environmental cleaning

Regular cleaning of work areas is important for the successful application of standard and additional precautions for controlling infection in health care establishments.

Deposits of dust, soil and microbes on environmental surfaces can transmit infection. Routine cleaning and maintenance is therefore necessary to maintain a safe environment in health care establishments. The following basic principles should be followed:

- written cleaning protocols should be prepared, including methods and frequency of cleaning; and

- standard precautions (including wearing of personal protective equipment as applicable) should be implemented when cleaning surfaces and facilities (see **Section 2.2**).

18.1.1 Surface cleaning

Floors should be cleaned daily, or as necessary.

- Floors in hospitals and day-care facilities should be cleaned daily, or as necessary, with a vacuum cleaner fitted with a particulate-retaining filter, which should be changed in accordance with the manufacturer's instructions (Ayliffe et al 1999).
- The exhaust air should be directed away from the floor to avoid dust dispersal.
- A ducted vacuum cleaning system can also be used, as long as safe venting of the exhaust air is ensured.
- Damp dusting is acceptable. Brooms disperse dust and bacteria into the air and should not be used in patient/clinical areas. Dust-retaining mops, which are specially treated or manufactured to attract and retain dust particles, do not increase airborne counts as much as ordinary brooms and remove more dust from surfaces (Ayliffe et al 1999). However, brooms and dust-retaining mops should not be used in clinical areas where there is a high risk of infection associated with dust (eg burns units).

Procedure for routine surface cleaning

- Work surfaces should be cleaned and dried before and after each session, or when visibly soiled. Spills should be cleaned up as soon as is practical (see **Section 18.2**).
- A neutral detergent and warm water solution should be used for all routine and general cleaning.
- When a disinfectant is required for surface cleaning, the manufacturer's recommendations for use and occupational health and safety instructions should be followed.
- Buckets should be emptied after use, washed with detergent and warm water and stored dry.
- Mops should be laundered or cleaned in detergent and warm water, then stored dry.

The ideal detergent

Detergents used for environmental cleaning should physically remove dirt/soils, suspend it in water and rinse free with little or no residue. Detergents should be low irritant to minimise skin problems for HCWs in contact with them.

Neutral pH detergents are best for environmental cleaning because they are less likely than acid or alkali detergents to damage metals such as stainless steel (Gardner and Peel 1998) or to cause skin irritation.

DISCUSSION POINT



Wet areas

Toilets, sinks, washbasins, baths, shower cubicles, all fittings attached to ablution facilities and surrounding floor and wall areas should be cleaned at least daily, or more frequently as required. Additional cleaning may be required for particular rooms (eg rooms with patients requiring additional precautions).

Cleaning methods should avoid generation of aerosols.

Walls and fittings

Walls, blinds and curtains should be cleaned regularly and when they are visibly soiled. Curtains should be changed regularly and as necessary. Carpets should be vacuumed daily.

Maintenance of cleaning equipment

Cleaning items (including solutions, water, buckets, cleaning cloths and mop heads) should be changed routinely. They should also be changed immediately following the cleaning of blood or body substance spills, or after each session for contaminated areas such as operating rooms or isolation rooms. These items should be washed/cleaned in detergent and warm water, rinsed and stored dry between uses. Detachable mop heads should be laundered between uses.

Spills of laboratory cultures of human pathogens

Spills of laboratory cultures should be absorbed on to paper towels and disposed of as clinical waste. The contaminated surfaces should be treated with 2.0–2.5% sodium hypochlorite, left for one hour and cleaned again with paper towels that are disposed of as clinical waste.

Cleaning for CJD infectious agents

Spills of central nervous system tissue or cerebrospinal fluid should be absorbed onto paper towels and disposed of by incineration. The surface should then be soaked with 1 molar sodium hydroxide or 2.0–2.5% sodium hypochlorite, left for one hour and cleaned again with paper towels that are disposed of by incineration.

Spills of blood or other body fluids and tissues should be cleaned using standard spill management procedures.

► **Table 31.9** details recommended reprocessing methods for CJD infectious agents.

Gloves used as personal protective equipment when cleaning contaminated surfaces should be incinerated after use.

DISCUSSION POINT



To disinfect or not to disinfect?

Disinfectants are often used to decrease the risk of exposure to bloodborne viruses after spills of blood or body substances onto environmental surfaces. However, viruses are more fragile than bacteria and require a living cell to remain viable. Therefore, removing physical debris, including any proteinaceous matter, cleaning with detergent and water and leaving dry is all that is routinely required to remove viruses.

Where there is the possibility of some material remaining on a surface where cleaning is difficult (eg between tiles) and there is a possibility of bare skin contact with that surface, then a disinfectant may be used after the surface has been cleaned with detergent and water (see **Section 18.2.1**).

18.2 Management of blood and body substance spills

18.2.1 General

Health care establishments should have management systems for dealing with blood and body substance spills, and procedural manuals should include protocols and emphasise ongoing education or training programs. The basic principles of blood and body substance spills management are:

- standard precautions apply (see **Section 2.2**), including use of personal protective equipment as applicable (see **Section 13**);
- spills should be cleared up before the area is cleaned (adding cleaning liquids to spills increases the size of the spill and should be avoided); and
- generation of aerosols from spilled material should be avoided.

Using these basic principles, the management of spills should be flexible enough to cope with different types of spills, taking into account the following factors:

- the nature of the spill (eg sputum, vomit, faeces, urine, blood or laboratory culture);
- the pathogens most likely to be involved in these different types of spills (eg stool samples may contain viruses, bacteria or protozoan pathogens; sputum may contain *Mycobacterium tuberculosis*);
- the size of the spill (spot, small or large spill);
- the type of surface (eg carpet or impervious flooring);
- the area involved (ie whether the spill occurs in a contained area such as a microbiology laboratory or in a public area such as a hospital ward or outpatient area); and
- whether there is any likelihood of bare skin contact with the soiled surface.

It is generally unnecessary to use sodium hypochlorite for managing spills but it may be used in specific circumstances (see **Section 18.1.1**). It is recognised, however, that some HCWs may feel more reassured that the risk of infection is reduced if sodium hypochlorite is used routinely. In that case, the practice need not be discouraged, but the HCW should be made aware that there is no evidence of benefit from an infection control perspective.

If a spill of tissue infected with CJD occurs (eg brain tissue), the contaminated item or surface should either be destroyed by incineration or cleaned with either sodium hydroxide or sodium hypochlorite according to the guidelines given in **Table 31.9**.

In areas such as hospital wards, waiting rooms and patient treatment areas, blood and body substance spills should be dealt with as soon as possible. In operating rooms, or in circumstances where medical procedures are under way, spills should be attended to as soon as it is safe to do so.

Blood and body substance spills should be dealt with as soon as possible.

Spots or drops of blood or other small spills can easily be managed by wiping the area immediately with paper towelling and then cleaning with water and detergent. A hospital-grade disinfectant can be used on the spill area after precleaning.

Where large spills have occurred in a 'wet' area, such as a bathroom or toilet area, the spill should be carefully washed off into the sewerage system and the area flushed with water and detergent.

Large blood spills that have occurred in 'dry' areas (such as a hospital ward or a patient treatment area in office practice) should be contained and generation of aerosols should be avoided.

Granular formulations that produce high available chlorine concentrations can contain the spilled material and are useful for preventing aerosols. A scraper and pan should be used to remove the absorbed material. The area of the spill should then be cleaned with a mop and bucket of water and detergent. The bucket and mop should be thoroughly cleaned after use and stored dry.

Care should be taken to thoroughly clean and dry areas where there is any possibility of bare skin contact with the surface (eg on an examination couch).

18.2.2 Cleaning equipment (spills kit)

Standard cleaning equipment, including a mop and cleaning bucket plus cleaning agents, should be readily available for spills management and should be stored in an area known to all HCWs. This is particularly important in patient areas such as hospital wards or treatment areas. To facilitate the management of spills in areas where cleaning materials may not be readily available, a disposable ‘spills kit’ could be used, with the following items:

- a large (10 L) reusable plastic container or bucket with fitted lid, containing the following items;
- appropriate leakproof bags and containers for disposal of waste material;
- a designated, sturdy scraper and pan for spills (similar to a ‘pooper scooper’);
- about five sachets of a granular formulation containing 10,000 ppm available chlorine or equivalent (each sachet should contain sufficient granules to cover a 10-cm diameter spill);
- disposable rubber gloves suitable for cleaning (vinyl gloves are not recommended for handling blood);
- eye protection (disposable or reusable);
- a plastic apron; and
- a respiratory protection device (for protection against inhalation of powder from the disinfectant granules, or aerosols, which may be generated from high-risk spills during the cleaning process).

With all spills management protocols, it is essential that the affected area is left clean and dry. Disposable items in the spills kit should be replaced after each use of the kit.

Sodium hydroxide spills kits should be available for areas at risk for higher-risk CJD spills, such as neurosurgery units, mortuaries and laboratories.

18.2.3 Spills in laboratories

The handling of spills within laboratories depends on the nature of the material and the volume. Small spills that can be cleaned up without generating aerosols can be managed as outlined above. Large spills of high-risk material with generation of aerosols will require the use of personal protective equipment, including appropriate respiratory protection.

Further details of spills management in laboratories can be found in AS/NZS 2243.3.¹

¹ AS/NZS 2243.3 (1995) *Safety in laboratories — Microbiology*.

19 Linen, laundry and food services

Key points

Linen and laundry

- ✚ Health care establishments and commercial linen services should have documented policies and procedures for the collection, transport and storage of all linen. Appropriate personal protective equipment should be worn when handling soiled linen. Linen heavily soiled with body substances or other fluids should be contained within suitable, securely closed, impermeable bags.

Food services

- ✚ Special conditions apply to food-handling procedures in health care establishments because some patients are at increased risk of contracting severe foodborne illnesses.
- ✚ Preparation of food requires particular attention to handling of raw materials, personal hygiene, kitchen hygiene and time–temperature control of all food-handling operations, including cooking, cooling, reheating and distribution.
- ✚ Food handling should comply with relevant State/Territory regulations and with national food safety standards.
- ✚ Food service departments should use a food safety plan based on the 'hazard analysis critical control points' (HACCP) approach to food preparation rather than a traditional (recipe-based) approach.
- ✚ Trolleys and refrigerators should be used only for their designated purposes.

19.1 Hospital laundries and commercial linen services

Health care establishments and commercial linen services should have documented policies and procedures for the collection, transport, processing and storage of all linen. AS/NZS 4146¹ provides guidelines for correct laundry practice. Standard precautions should be followed (see **Section 2**). The basic principles of linen management are as follows:

- place linen in appropriate bags at the point of generation;

¹ AS/NZS 4146 (2000) *Laundry practice*.

- contain linen heavily soiled with body substances or other fluids within suitable impermeable bags and close the bags securely;
- do not rinse or sort linen in patient care areas (sort it in appropriate areas); and
- separate clean from soiled linen and transport/store separately.

Care should be taken to ensure that sharps and other objects are not inadvertently discarded into linen bags. Bags should not be overfilled, as this may prevent closure, increase the risk of rupture of the bags in transit and increase the risk of injury to waste handlers.

AS 4480.1² provides guidelines for correct care and laundering of sheepskins.

A hot water and detergent solution is adequate for cleaning most laundry items. Water temperature and time for correct thermal disinfection is stated in AS/NZS 4146. Disposable linen and protective clothing should be used for neurosurgery or interventional neuroradiology on patients in a risk group for CJD (see **Section 31.12** and **Table 31.6**).

19.2 Food services

19.2.1 Introduction

Food service establishments are frequently identified as places where mishandling of food has led to outbreaks of foodborne disease (Bryan 1990). Hospitals and other health care establishments represent a special case of food service operation.

Some patients are at increased risk of severe foodborne illness, and particular care must be taken to minimise the risk of infection or toxic poisoning through the food service system. Historically, *Clostridium perfringens*, a spore-forming anaerobe able to multiply at 12–55°C, has posed special problems in food service situations (Andersson et al 1995, Ryan et al 1996, Meer et al 1997). However, any foodborne pathogen poses some risk; with the array of food service systems now available to health care establishments, no organism can be singled out for special attention. *Salmonella* spp (Dryden et al 1994, L'Ecuyer et al 1996), *Listeria monocytogenes* (Elsner et al 1997) and viruses (Cáceres et al 1998) have been implicated in recent overseas outbreaks of health care associated infections. Some outbreaks have occurred in foods usually considered to be 'low risk' (Lund 1993, Nguyen and Carlin 1994, Hocking et al 1997), indicating that all foods should be considered to be potential sources of infection and included in the food safety program.

² AS 4480.1 (1998) *Textiles for health care facilities and institutions — Medical lambskins — Product specification and testing*.

Preparation of food requires attention to raw materials, personal hygiene, kitchen hygiene, and especially time–temperature control of all food-handling operations, including cooking, cooling, reheating and distribution.

▷ Further details about listeria and other enteric bacteria are given in **Sections 29.3** and **29.1**, respectively.

19.2.2 Australian food standards

Food preparation and handling in health care establishments should comply with relevant State/Territory regulations. Assuring safe food requires identification and control of microbiological, chemical and physical hazards. Since 1995, Food Standards Australia New Zealand (formerly the Australia New Zealand Food Authority) has been developing uniform national food safety standards based on the 'hazard analysis critical control points' (HACCP) approach (see **Section 3.2**). Four standards have been drafted that require businesses to:

- notify the relevant authority of their existence and the nature of the business;
- develop and comply with a food safety program;
- carry out specific practices in relation to food handling, cleaning/disinfecting and personal hygiene;
- provide for food recalls;
- ensure that staff and supervisors have skills and knowledge in food safety; and
- ensure that food premises and equipment meet with specified design and construction requirements.

This approach gives industry greater flexibility to achieve safe food outcomes, whilst incorporating modern food safety practices based on a preventative approach. When finalised, the standards will be adopted into the Australia New Zealand Food Standards Code (FSANZ 2000, 2001) and incorporated into the food standards legislation of each State and Territory. Each State and Territory is currently at a different stage in implementing these standards.

19.2.3 HACCP-based food safety programs

HACCP is an approach to infection control that identifies specific hazards and specifies measures for their control. It is based on seven basic principles, which can be applied to identify hazards and determine and monitor critical control points.

HACCP can be applied to identify hazards and determine and monitor critical control points.

The Victorian Government has anticipated the national standards, and already requires food businesses to develop HACCP-based food safety programs and register these with local councils (Food Safety Victoria 1999). This includes food service operations in health care establishments, although such establishments may not strictly be food businesses as defined in the draft legislation.

It seems likely that other States and Territories will follow the Victorian position, requiring kitchens in health care establishments to comply with the proposed legislation and have their food safety plans registered and subjected to external audit. Even if this does not occur, there are sound technical and management reasons for kitchens in health care establishments to develop and implement HACCP-based food safety plans relevant to their processes.

Many available publications describe the theory and practice of HACCP-based systems, including some with particular reference to food service (Bryan 1992, Campden and Chorleywood Food Research Association 1997, Codex Alimentarius Commission 1997, Institute of Hospital Catering 1997, Mortimore and Wallace 1998, Food Safety Victoria 1999).

Food service departments should take a systematic approach to HACCP.

It is recommended that food service departments in health care establishments take a systematic approach to HACCP, instead of the traditional approach based only on cooking procedures. The ‘recipe-based’ approach may not address all the steps that a food product passes through, including receipt of goods, meal service and distribution.

An important aspect of a food safety plan is the development of an accurate flow diagram for each production system or process. **Figure 19.1** shows a theoretical flow diagram that can be applied to many food service lines. Following observation during normal production, the operation is divided into the key activities. Minor activities that occur at each step are also noted for consideration. Using the flow diagram as a guide, the HACCP team should conduct a hazard audit for each process line. An example is given in **Table 19.1**.

Table 19.1 Example hazard audit table for a product

Step	Hazard	Control measure	Critical control points	Critical limit	Monitoring procedure	Corrective action	Records

Source: Campden and Chorleywood Food Research Association (1997)

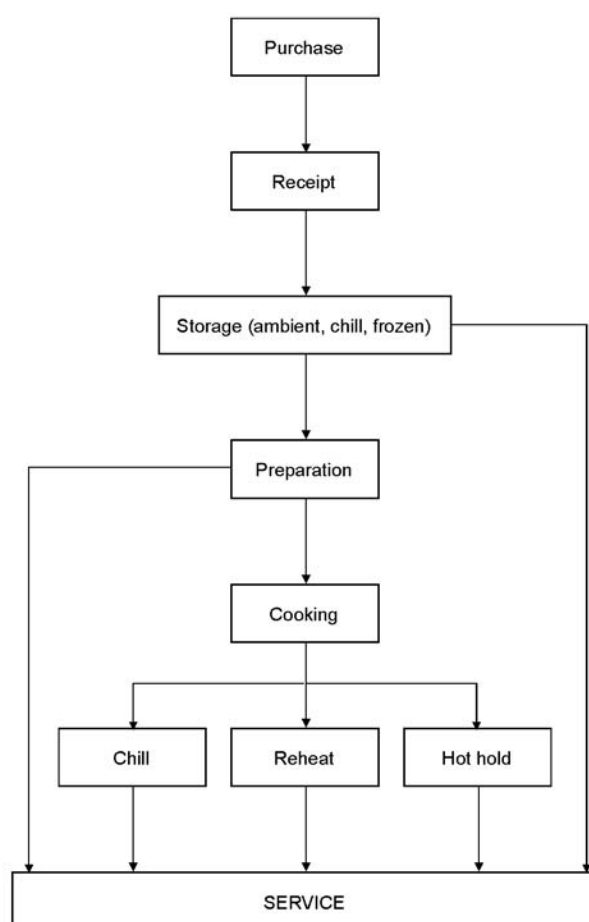


Figure 19.1 Theoretical HACCP flow diagram for many food service lines

19.2.4 Support programs

The application of good manufacturing practice throughout the food service chain is an integral part of a properly constructed HACCP plan. This includes factors that have become known as prerequisite or support programs, including supplier control, cleaning and sanitation, personal hygiene and staff training. The Australia and New Zealand Food Standards 3.2.2 and 3.2.3 cover the issues that should be addressed by HACCP support programs. Further information is available in the literature (eg Sperber et al 1998).

Good manufacturing practice is an integral part of a properly constructed HACCP plan.

Food handlers' personal hygiene is particularly important, as bacteria can be transferred from the handler to the food and food-contact surfaces during preparation. Furthermore, some people are carriers of pathogenic organisms. For example, 2–6% of people are permanent carriers of *Listeria monocytogenes* (Paul et al 1994, Hocking et al 1997).

19.2.5 Special issues for health care establishments

Cook–chill food production systems

An increasing trend in health care establishments is to use ‘cook–chill’ food service systems to extend the life of prepared food products. The time and temperature control of product chilling and subsequent storage and handling are critical in cook–chill systems because bacteria can grow in the extended time between food production and consumption. The storage temperature for cook–chill systems should be 0–3°C, which is lower than that required for conventional cold storage (Institute of Hospital Catering 1997, NSW Health 1995ab). The storage time (shelf life) must also be closely monitored and may vary according to the production method used, as well as the storage temperature (Abhayaratna and Zemanovic 1992, NSW Health 1995ab).

Listeria monocytogenes

Although storage below 3°C controls the growth of most pathogenic bacteria, *Listeria monocytogenes* can multiply at temperatures as low as 1°C. Although growth is slow at such low temperatures, prolonged storage of products can result in significant levels of bacteria (Hocking et al 1997).

To control the risk of *Listeria monocytogenes* infection, food safety programs in health care establishments need to use strict time and temperature control, alternative bactericidal processes (eg chlorine sanitation of raw vegetables) and avoidance of certain high-risk foods (Brackett 1987, Hurst and Schuler 1992, Bartlett 1993).

Texture modified meals

Texture modified meals, which are provided to people with chewing and/or swallowing problems, have a greater risk of bacterial contamination than other foods. This category of food includes all food that has been pureed or minced after cooking (Tallis et al 1999). Where possible, food should be pureed before cooking. Where this is not possible (for example with pureed fruit), particular care must be taken to minimise cross-contamination. Strict time and temperature control must be maintained (Food Safety Victoria 1999).

Nutritional implications

There have been recommendations that some items should be removed from the menus of health care establishments or should have restricted shelf lives, due to the potential risk associated with these foods (eg dairy-based desserts and drinks, some salad vegetables, and cold cut meats) (NSW Health 1999). However, this approach would make it more difficult for health care establishments to provide adequate nutrition to some patient groups, and could increase the incidence of malnutrition (Zador and Truswell 1987, Ferguson et al 1997) and lead to poorer patient outcomes (Reilly et al 1988, Coats et al 1993, Callagher-Allred et al 1996, Chima et al 1997).

With the implementation of an appropriate HACCP-based food safety program that addresses the process issues of the health care establishment concerned, such measures should not be necessary.

19.2.6 Food handlers and hygiene

HCWs who handle food should receive appropriate education about personal hygiene and foodborne diseases.

HCWs who handle food should receive appropriate education.

HCWs with active diarrhoea should not handle food until they have been cleared for food-handling duties by a medical practitioner. Open skin lesions should be covered to prevent potential food contamination with bacteria (eg staphylococci). HCWs who are carriers of certain enteric pathogens (eg salmonella) should obtain clearance from a medical practitioner before resuming food-handling duties. State/Territory health department regulations governing food handlers should be followed.

19.3 Refrigerators

Food should not be stored with contaminated material, clinical specimens or medical products such as drugs, vaccines and blood. Food storage refrigerators for HCWs should be clean and the temperature monitored according to the Food Standards Code (FSANZ 2001).

Vaccines and other medications should be stored in accordance with the manufacturer's instructions and the 'cold chain' maintained as described in *The Australian Immunisation Handbook 8th Edition* (Section 1.10; NHMRC 2003).

Blood should be stored in accordance with AS 3864³ (see **Section 25.3.5**).

19.4 Ice machines

Ice machines in health care establishments have been implicated in outbreaks of infection and as potential reservoirs of infectious agents (Laussucq et al 1988, Burnett et al 1994, Graman et al 1997) and should comply with AS/NZS 3350.2.24.⁴ Ice machines should be maintained and serviced regularly. Implements (eg scoops, tongs) should be used only for their intended purpose. Water supplied to ice machines should comply with State/Territory guidelines for potable water.

³ AS 3864 (1997) and Amendment 1 (1998) *Medical refrigeration equipment — For the storage of blood and blood products*.

⁴ AS/NZS 3350.2.24 (1998) *Safety of household and similar electrical appliances, Part 2.24: Particular requirements — Refrigerating appliances and ice makers*.

19.5 Trolleys

Mechanical transport is often the most efficient way of distributing equipment in hospitals and other large health care establishments. Trolleys should be appropriate for their intended purpose, be dedicated to one purpose (food, linen, sterile equipment, waste etc) and should be enclosed or draped. Trolleys should comply with occupational health and safety requirements and should be cleaned every day (more frequently when soiled) to make sure they are maintained in a clean, hygienic condition.

20 Therapeutic devices

Key points

Indwelling urinary devices

- ✦ Indwelling urethral and suprapubic catheters provide a route for infectious microorganisms to enter the urinary tract and bladder.
- ✦ Devices should not be left indwelling unless absolutely necessary because the incidence of infection increases with the length of time the catheter is in place (almost 100% by one month).
- ✦ Health care establishments should ensure that health care workers (HCWs) are trained in the correct aseptic insertion methods and in the maintenance of devices to reduce the risk of infection.
- ✦ Patients should be told about any risks associated with their device and about its maintenance. The importance of noninterference should be stressed.

Intravascular access devices

- ✦ Intravascular access devices are potential sites for local infections and provide a route for infectious agents to enter the bloodstream and cause serious bloodstream infections.
- ✦ Intravascular devices should only be used when absolutely necessary and must not remain in situ unnecessarily.
- ✦ Health care establishments should ensure that HCWs are trained in strategies to minimise the risk of infection, including the rigorous use of aseptic technique for insertion and maintenance of the device.

20.1 Indwelling urinary devices — urethral and suprapubic catheters

20.1.1 Description and role

A urinary catheter is a tubular flexible or nonflexible instrument passed into the bladder either through the urethra or through the abdominal wall above the symphysis pubis to:

- empty the contents of the bladder;
- obtain a sterile urine specimen; or
- determine the amount of residual urine in the bladder after voiding.

Indwelling urethral and suprapubic catheters are a potential portal of entry for infectious microorganisms.

A flexible urinary catheter inserted into the bladder either via the urethra or abdominal wall may be left 'indwelling' as a passage for drainage.

20.1.2 Infection risks

Indwelling urethral and suprapubic catheters are a potential portal of entry for infectious microorganisms. These can enter the bladder from colonisation at the entry site or by microbes contaminating ports from external sources, such as the hands of health care workers (HCWs) or the skin of the patient.

About 10% of hospitalised patients have an indwelling urinary catheter. The incidence of infection is directly related to the length of time that the catheter is in place. For the first two weeks of catheterisation, there is a linear relationship between acquisition of new infections and the duration of catheterisation; 50% of patients become infected by day 15 of catheterisation, and almost 100% by one month (APIC 1999).

A break in aseptic technique during the insertion of the catheter or when servicing the drainage/collection system may allow microorganisms to enter and cause a urinary tract infection. Serious infections associated with indwelling urinary devices can occur, with 1–2% proceeding to septicæmia (APIC 1999).

The following strategies should be used to avoid infection:

- The device should not be left indwelling unless absolutely necessary.
- The same aseptic precautions should be carried out for urethral or suprapubic catheterisation as for a minor surgical procedure.
- HCWs who perform catheterisation should be trained and competent in the technique (Pratt et al 2001).
- To avoid trauma, HCWs should select the smallest bore catheter that will not be associated with leakage.
- The urethral insertion site should be cleaned (using either soap or water or a suitable antiseptic solution) and then dried.
- Sterile water-soluble lubricant must be applied to the catheter before it is inserted into the urethra, to reduce friction and trauma to the urethral opening.
- A closed sterile drainage/collection system should be attached to the catheter and maintained at all times.
- If there is no balloon on the catheter (to hold it in place), the device should be stabilised against movement.
- If the site is to be dressed (eg suprapubic), the dressings surrounding the device must be sterile.

Faecal bacteria can be transported to the urinary meatus. Wiping following bowel movements should be carried out from front to back.

Vaginitis should be treated promptly and effectively to reduce the risk of spreading infection from the vagina to the opening of the urethra.

20.1.3 Management issues

Health care workers

Policies and procedures regarding the insertion, maintenance and changing regimes of indwelling urinary devices should be written and reviewed every three years and/or updated as necessary. These policies should be readily accessible.

Policies and procedures regarding indwelling urinary devices should be readily accessible.

Orientation programs and regular education programs should include instruction on the importance and principles of catheterisation and the care of the patient with an indwelling urinary device.

Patients

The patient should understand the nature of an indwelling urinary device and the reason for its insertion. Emphasis should be placed on noninterference with the device or the collection system other than by people who are competent in the use of the device and in aseptic technique.

In many cases there are no symptoms in catheterised patients who have significant bacteriuria. In others, suprapubic pain and urethral burning may develop. The patient should alert HCWs to pain or discomfort, fever, chills or sweats.

Patient care and maintenance of devices

- Increased intake of fluids should be encouraged (unless medically contraindicated) to facilitate the removal of microorganisms and debris.
- Perineal/vulval washing should be carried out regularly (twice daily), as well as after a bowel motion.
- Cleaning of the catheter and the insertion site should be carried out regularly (twice daily) to avoid encrustation.
- Closed drainage/collection systems should not be opened unless necessary.
- The ports should be aseptically swabbed with an antimicrobial solution and allowed to dry immediately before use in order to prevent the entry of microorganisms into the line.
- The interruption of urine flow should be avoided, as should the interruption of routine irrigation of urinary catheters.
- Urine samples should be collected from the closed system with a syringe and needle (after cleaning the port), not by breaking the connection between the catheter and the drainage/collection system, and never from the drainage tap attached to the collection container itself.

- Before collecting urine samples or emptying the collection container, HCWs should wash their hands and then put gloves on. They should wash their hands after removing the gloves.
- The collection container should neither be raised above the level of the urethra nor allowed to trail on the floor.
- If there is a risk of urinary reflux when the patient is being moved, the tubing should be clamped temporarily, then unclamped afterwards.

Further maintenance issues

Additional measures that have been applied to the management of urinary catheters, but for which there are no data confirming efficacy, include:

- replacing the collecting system when sterile closed drainage has inadvertently been violated;
- separating infected and noninfected catheterised patients; and
- regular bacteriological monitoring of catheterised patients.

The following points should also be noted:

- Routine changing of urinary catheters at arbitrarily fixed intervals in the absence of leakage, malfunctioning or palpable concretions in the lumen is not recommended.
- Continuous irrigation of the bladder as an infection control measure has not been shown to reduce urinary tract infections.
- Applying antimicrobial ointment to the urethral meatus has not reliably been shown to reduce the incidence of urinary tract infections.
- The addition of antiseptic or antimicrobial agents to the collection system container has not yielded conclusive results (APIC 1999).

Devices

Before use, all equipment must be checked for:

- expiry dates;
- integrity of containers/packages; and
- the correct amount of sterile water required to be inserted if the device has a balloon.

After insertion:

- the catheter and drainage system must be inspected at least daily and the results documented; and
- the date and time of catheter changes should be documented.

The optimal time limit for replacing catheters depends upon individual circumstances and the type of catheter used. Health care establishments should have written policies on the time limit.

In establishments (or particular areas within establishments) where the incidence of catheter-related urinary tract infections is higher than acceptable standards from national health care associated infection surveillance data, consideration may be given to silver-hydrogel-impregnated indwelling urinary catheters. In a recent study it was found that this antiseptic impregnated catheter was most effective in reducing catheter-associated urinary tract infections (CAUTIs) if infection was caused by enterococci, coagulase-negative staphylococci or candida, but had little effect on CAUTIs caused by gram-negative bacilli (Maki et al 1998).

Environment

Urethral catheterisation is usually carried out in a clinical setting and the environment should be managed as for minor surgical procedures. Before the procedure, the environmental surfaces involved should be effectively cleaned. The same effective cleaning should be done before the insertion of a suprapubic catheter, although this procedure is often carried out in an operating room.

Device reprocessing

Indwelling urinary catheters have narrow hollow lumens and cannot satisfactorily be cleaned. Also, the physical characteristics of the latex or plastics may not withstand cleaning and resterilising (Collignon et al 1996). These items, together with drainage/collection systems, are manufactured for single use only and must not be reused.

Indwelling urinary catheters are manufactured for single use only and must not be reused.

20.1.4 Monitoring and surveillance

Routine bacteriological testing is not cost effective. Health care establishments should devise a sampling system concentrating on departments with higher rates of indwelling urinary device related infections and act upon the results (Meers et al 1997).

20.2 Intravascular access devices (catheters)

20.2.1 Description and role

Indwelling intravascular access devices provide a route for administering fluids, blood products, nutrients and intravenous medications; for monitoring haemodynamic function; for maintaining emergency vascular access; and for obtaining blood specimens. They are an integral part of patient care (Pearson 1996). Intravascular devices are usually inserted into veins — intravenous insertion — but can, on occasion, be intra-arterial (eg for blood pressure monitoring). Most venous catheters that are inserted are short (less than 5 cm) and are inserted into peripheral veins (eg smaller veins in the arms).

Central venous catheters (CVCs) are increasingly being used; these are usually much longer (more than 15 cm) and remain in place for longer than peripheral vein catheters. Central veins are defined as the larger veins of the body that lie within the 'central' parts of the body (chest and abdomen). Some CVCs may be inserted via a peripheral vein site, with their tip advanced until it is situated within a central vein. These are known as peripherally inserted central catheters (PICCs).

Intravascular access devices provide potential routes for infectious agents to cause local infection or to enter the bloodstream. They are now a common source of serious illness or death for some patients. The risk of infection associated with them can be minimised by adherence to appropriate infection prevention precautions. The use of intravascular devices is also associated with noninfective risks (eg pneumothorax occurring during CVC insertion via the subclavian vein).

Intravascular access devices should be used only when absolutely necessary and must not remain in situ unnecessarily.

To minimise the risks associated with catheter use, intravascular access devices should be used only when absolutely necessary and must not remain in situ unnecessarily.

20.2.2 Infection risks

Serious infections associated with intravascular devices are common. In Australia over 3500 bloodstream infections occur per year (bacteraemia or fungaemia). In the United States and Europe, there are likely to be over 500,000 bloodstream infections per year. The reported associated mortality rate varies between 5% and 25%. Many patients have serious underlying diseases, making them more susceptible to infections. The increased mortality in seriously ill patients that can be directly attributed to intravascular catheter bloodstream infection is about 10% (Crump and Collignon 2000).

Two or more prospective studies have identified the following independent risk factors for intravascular device related infections (APIC 1999):

- prolonged hospitalisation before insertion of the intravascular device;
- prolonged duration of insertion of the device;
- heavy microbial colonisation of the insertion site;
- heavy microbial colonisation of the cannula/catheter hub;
- catheter insertion in the internal jugular vein compared with subclavian or femoral vein insertion; and
- antibiotic use during catheterisation.

Changes in medical and nursing practices can influence many of these risk factors. For example, prolonged duration of catheter insertion is common even when the intravascular catheter is no longer essential. CVCs should not be left in place for intravenous feeding (total parenteral nutrition) when absorption may be possible through a nasogastric tube (Collignon 1995). Heavy

colonisation of the catheter hub is not uncommon, but is usually secondary to contamination by the hands of HCWs. This can be reduced by improved aseptic technique and by trying to minimise the number of times the catheter hub is flushed or used.

Most infectious agents reach the intravascular device tip from skin flora colonising the entry site wound or microbes contaminating the delivery system hubs from external sources (eg HCWs' hands or the skin of the patient).

Contamination of infusion solutions is currently considered a relatively rare occurrence.

20.2.3 Strategies for minimising infection

The risk of cross-infection by HCWs can be reduced by:

- the use of insertion techniques that ensure sterility of the device while it is being inserted;
- thorough handwashing with an appropriate antimicrobial solution before putting on sterile gloves and inserting the intravascular device, or when changing/maintaining solution containers, lines or dressings;
- cleaning the insertion site with an effective antiseptic approved by the health care establishment's pharmacy/drugs and therapeutics committee (the cleaned area must be completely dry before the device is inserted); and
- for CVC catheters, the wearing of sterile barrier attire and the use of large sterile drapes during the insertion of central lines or guide-wire exchange.

Strategies that best reduce the risks are:

- adequate aseptic technique during insertion and maintenance of the device;
- the use of new device materials that decrease the adherence of infectious agents; and
- appropriate limits on the duration of device use (APIC 1999).

Other strategies for avoiding infection are:

- excess hair removal by clipping (not shaving) before insertion; and
- selection of a catheter with a smaller lumen than that of the vessel to be entered to reduce the incidence of trauma, which predisposes to infection.

20.2.4 Management of devices

Health care workers

Policies and procedures regarding the insertion and maintenance of intravascular access devices should be written and reviewed every three years and/or updated as necessary and approved by an authoritative body (infection control committee and/or drugs and therapeutics committee). These policies must be readily accessible.

Maintenance guidelines should include:

- hub and injection port care;
- whether CVC and PICC line tips must be sent for microbial examination and culture upon removal (usually only where clinical sepsis was suspected would catheters be sent for culture); and
- the optimal time after which solution containers with additives should be changed.

The health care establishment should provide planned, regular education programs for all HCWs whose duties include any aspect of intravascular access and management.

During orientation programs, relevant HCWs should be made aware of the importance and principles of safe intravascular access. The health care establishment should provide planned, regular education programs for all HCWs whose duties include any aspect of intravascular access and management.

Patients

The patient should understand the nature and reason for any intravascular therapy. Only appropriate HCWs should handle the cannula/catheter, lines and solution containers.

Devices

- Before use, all equipment must be checked for:
 - expiry dates;
 - integrity of the container/package;
 - macroscopic contamination; and
 - clarity of solution (if meant to be clear).
- The insertion sites must be cleaned with antimicrobial solution and allowed to dry (see **Section 7.3**). Insertion of the devices must be performed using aseptic technique.
- Stabilisation of the devices (with tape) reduces the potential for complications such as phlebitis, subcutaneous infiltration, sepsis and cannula/catheter movement. Sterile tape only should be used to stabilise the devices. Dressings covering the devices must be sterile.
- The date and time of insertion should be documented in the patient's progress notes, in the care plans and on the occlusive dressing.

- The injection ports must be aseptically swabbed with an antimicrobial solution immediately before use, in order to prevent infectious agents entering the vascular system.
- The site must be inspected, attended and documented at least daily. Regular, standardised site inspection and dressing change minimises intravascular device related sepsis.
- It is recommended that administration sets be changed aseptically every 24–48 hours, upon suspected contamination or when the integrity of the product has been compromised. The type of solution or frequency of drug administration may dictate a more frequent set change.
- Peripheral venous sites should be changed every 48 hours (up to 72 hours if therapy is to cease).
- The device, associated giving set and site of insertion should be changed at the first sign of phlebitis (Collignon et al 1984).
- All catheters inserted in a lower extremity or without proper asepsis during an emergency must be changed as soon as a satisfactory site can be established in an upper extremity.
- Removal of the device should be carried out aseptically and a sterile dressing applied.
- The date and time of site changes must be documented.
- The optimal time limit for replacing catheters, administration sets or fluid containers depends upon individual circumstances. Duration of use limits and the priority assigned to corrective measures should be established relative to reported aggregate infection rates and where possible to established benchmarks. Health care establishments that fail to achieve low infection rates should consider adopting more conservative limits (Health Canada 1997).

Where the incidence of catheter-related bloodstream infection in a health care establishment (or particular area of a health care establishment) remains significantly greater than 1%, or greater than expected based on national health care associated infections surveillance data, consideration should be given to the use of commercially available antiseptic-impregnated cuffs and catheters. Silver-impregnated cuffs or chlorhexidine–silver sulfadiazine-impregnated catheters should be considered if the catheter duration is less than 2–3 weeks (APIC 1999). When prolonged intravenous access via a CVC is likely, catheters such as Hickman catheters — which have a cuff, are tunnelled subcutaneously and are associated with a lower sepsis rate than standard CVCs — should be used.

Environment

Dust, soil and microbial contaminants on environmental surfaces are not very likely potential sources of nosocomial infection whilst intravascular access devices are in situ. However, the environmental area and surfaces should be effectively cleaned before intravascular devices are cleaned, maintained or removed.

Device reprocessing

Intravascular devices are manufactured for single use only and must not be reused.

Intravascular devices are single use only and must not be reprocessed. The narrow lumens of catheters and lines cannot be satisfactorily cleaned and the plastic may not withstand cleaning and sterilising (Collignon et al 1996). These items, together with solution containers, are manufactured for single use only and must not be reused.

20.2.5 Monitoring and surveillance

Each health care establishment must tailor its surveillance systems to maximise the use of all health care resources, given outcome priorities, population characteristics and institutional objectives. Establishments should clearly define the nature of intravascular device-associated infections, the documentation required and any action to be taken.

Data collection should be tied to action in risk reduction, in process and systems improvement and in the achievement of desired outcomes for patient care.

21 Surveillance and outbreak investigations

Key points

- ✦ All health care facilities, including office practices, should collect data on health care associated infections, infection control breaches, outbreaks of infectious disease and antimicrobial resistance. The surveillance systems used by different health care establishments depend on the type and size of the establishment, its case mix, and the facilities and resources available.
- ✦ Effective surveillance systems can monitor changes in the rate of infection against a baseline rate, evaluate the effectiveness of new infection control policies and facilitate the early detection of outbreaks.
- ✦ A comprehensive 'minimum data set' forms the basis of all surveillance systems. Surveillance of health care associated infections draws information about the agent, host, environment and risk factors from a number of data sources (eg medical and pharmacy records, and laboratory data) and should include the incidence and prevalence of antibiotic-resistant bacteria and resistance genes. Postdischarge surveillance and surveillance of community-based health care practices should also be considered.
- ✦ When an outbreak is detected, the health care establishment's infection control management system should be notified and an outbreak control team formed. The principles for investigating outbreaks in health care establishments are the same as for community-based outbreaks; to stop the outbreak and prevent it reoccurring, an epidemiological investigation is conducted to identify the aetiological agent, the route(s) of transmission, exposure factors and the population at risk.
- ✦ Because of the increasing risk of litigation, all outbreaks, however minor, should be investigated thoroughly and the outcomes of the investigations documented. Therefore, all establishments should have adequate resources for the detection and control of outbreaks.

21.1 Introduction

Surveillance of health care associated infections or events is a continuous or periodic activity of data collection, analysis, interpretation and timely feedback of results to clinicians so that they may learn and apply appropriate clinical management intervention.

Surveillance of health care associated infection or events requires:

- the use of standardised definitions (where none exist, use definitions that have the widest possible peer acceptance);
- the use of standardised methodology for identification of at-risk patient groups and the cases of health care associated infection or events that manifest in these groups;
- data analysis using rates and/or process control charts (the frequency of analysis will depend on the size of the at-risk patient groups surveyed and the number of cases identified within each group); and
- timely feedback of interpretation of data to clinical and management staff.

A change in infection rates can be used to evaluate new infection control policies.

Surveillance procedures should be carried out in each health care establishment to obtain baseline information on the frequency and type of health care associated infections at the establishment. Any increase in the rate of infection can then be quickly recognised and appropriate infection control action taken to minimise transmission to other patients and health care workers (HCWs). A change in infection rates against a baseline rate can also be used to evaluate the effectiveness of new infection control policies and procedures.

The risks to patients or HCWs of acquiring a health care associated infection are described in **Section 4**. The nature and frequency of such infections varies in different health care settings. For example, in acute care, hospital patients are undergoing a range of invasive procedures and antibiotics, which may facilitate the emergence of antibiotic-resistant bacteria, are used frequently. Patients in long-term care, such as residential aged care, are often immunocompromised due to age or medications. Outbreaks of foodborne infections and skin conditions such as scabies are known to occur in these environments.

Where it is necessary for a patient's personal information, including health information, to be used or disclosed for purposes other than the purpose for which the information was originally collected, it will be necessary for establishments to take account of specific requirements under the *Privacy Act 1988* and any other legislative or ethical guidelines.

The National Health and Medical Research Council publication *Guidelines under Section 95 of the Privacy Act 1988* provides further information on the protection of privacy in relation to the compilation or analysis of statistics for health services management or medical research. It is available on the Department of Health and Ageing website.¹

¹ <http://www.health.gov.au/nhmrc>

21.1.1 Critical incidents

If there has been a breakdown in an infection control procedure or protocol, a 'lookback' investigation may be necessary to identify, trace, recall, counsel and test patients or HCWs who may have been exposed to an infection, usually a bloodborne virus. Lookback investigations must be managed with due regard to ethical and legal considerations. In the event of such an incident (eg failure of sterilisation or disinfection), the local public health unit should be advised immediately.

Lookback investigations must be managed with due regard to ethical and legal considerations.

21.2 Surveillance methods

21.2.1 General

Surveillance systems should be flexible enough to accommodate technological changes within health care establishments, shortening lengths of stay, and the necessity to provide post-discharge surveillance, including surveillance of procedures carried out in the community (eg 'hospital in the home' programs). Where possible, denominator data should be collected in all situations for the calculation of rates of infection.

Different health care establishments may have different methods of surveillance to monitor health care associated infections. For example, some establishments may have a higher-risk patient profile and therefore carry out more frequent and detailed monitoring.

To work within the resources available for surveillance, most health care establishments will choose a 'sentinel' at-risk patient group for routine surveillance. This group should be chosen only after examining historical surveillance data to identify the group considered most at risk and the 'core' business patient groups (McLaws and Caelli 2000). Where health care establishments do not have historical data, the infection control committee should identify their at-risk groups after examining results from laboratory-based data or performing a point prevalence survey of surgical and intravascular line patients in situ. There are three main types of surveillance program:

Sentinel groups can aid routine surveillance.

- Active surveillance by infection control practitioners who directly observe the selected at-risk patients and their medical records to collect denominator and numerator data. This practice is suited to the important health care associated infections such as surgical site infections and intravascular line-related bloodstream infections (BSIs).
- Passive surveillance. This may involve the use of case mix (diagnostic related group) and/or laboratory-based data or the monitoring of antibiotic resistance patterns, especially the frequency of multiresistant organisms (eg extended B-lactamase producing gram-negative bacteria, methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci).

- An alternative to active surveillance of intravascular-related BSIs is the use of passive laboratory-based surveillance for the identification of BSIs, with a quarterly audit of patients to establish the type and the number of intravascular line-days. The BSI rate per 1000 line-days by specific line types can then be calculated.

A 'minimum data set' for the surveillance of health care associated infections should include:

- details of the infected individual (name or other unique identifier);
- gender;
- hospital record number;
- ward or location in the hospital;
- name of the consultant and/or unit involved;
- date of admission, date of onset of infection and date of discharge or death (so that length of stay attributed to the health care associated infection can be calculated and community acquired infections excluded from further analysis);
- site of infection/colonisation;
- organism isolated or otherwise identified (eg serology);
- relevant characteristics of the organism (eg antibiotic sensitivity, biotype or genotype); and
- acknowledgment of appropriate data use against relevant privacy legislation.

This minimum data set should also include information on medical treatment/procedures at the time of infection, any other information relevant to possible causes of the infection (including the patient's underlying medical risk factors), clinical outcome and an assessment of whether the incident was preventable.

21.2.2 Occupational exposure and accidents with infection

Incidents of occupational exposure to blood and body fluids should be identified in all health care establishments. In addition, they should be incorporated in State/Territory and national systems for surveillance. An enhanced data set for occupational exposure to risk materials should include:

- the extent of the exposure;
- the site and severity of the injury;
- the nature of the exposure (percutaneous or mucous membrane exposure);
- the location in the establishment (ward or other location);
- the activity or procedure;
- the implement causing the injury;
- the infectious agent involved, if known;

- details of the treatment and prophylaxis given; and
- the outcome of the incident.

For blood and body fluid exposures (needlestick and similar injuries), the following details should also be recorded:

- identifying details of the source patient; and
- information on bloodborne virus risk and/or other relevant infectious disease risks.

These items are also relevant for recording potential transmission from an infected HCW to a patient.

21.2.3 Benchmarking and comparison

Comparison of infection rates between establishments and the publication of such comparisons is a contentious issue and needs careful consideration and sensitive handling. In large establishments, the best and most effective surveillance will target areas of high infection risk. However, to generate meaningful infection rates, the data need to be appropriately risk-adjusted, especially when they are released beyond the institution. Surveillance systems in small institutions should collect data on health care associated infections across the whole range of services provided.

Data collated to form a national picture must be interpreted with caution: the data may not be comparable, and the range of institutions involved will introduce confounding factors inherent in all surveillance systems. Differences specific to health care establishments include the catchment area of referral, the level of referral, the size of the institution and the specialty services provided. Problems of data interpretation can be overcome when surveillance systems are set up with clearly defined surveillance objectives, including the expected outputs of surveillance.

21.2.4 Surveillance of antibiotic-resistant organisms

Hospitals and diagnostic pathology laboratories should support comprehensive programs for the surveillance and management of antibiotic-resistant organisms.

Hospitals and laboratories should support the surveillance and management of antibiotic-resistant organisms.

Several groups are collecting national data:

- Since 1985, the Australian Group on Antibiotic Resistance has collected data on the antibiotic susceptibility of *Staphylococcus aureus* from hospital laboratories around the country.
- The Australian Gonococcal Surveillance Program was established as a long-term collaborative program conducted by reference laboratories in each State/Territory, to monitor the antibiotic susceptibility of gonococcal isolates. Data have been published quarterly since 1981, and annual reports since 1996.

- The Surveillance Network is a United States based organisation that collects qualitative and quantitative antimicrobial test results. A representative group of Australian laboratories and hospitals began contributing data in 1999.

The Commonwealth Government Response to the Report of the Joint Expert Technical Advisory Committee on Antibiotic Resistance (JETACAR)² recommends that a comprehensive antibiotic resistance surveillance system be established as part of a national antibiotic resistance management program (recommendations 10 and 11). The overall surveillance system should include medical, food-producing animal and veterinary areas, with an emphasis on the food chain, molecular studies of resistance genes and environmental connections.

21.2.5 Health care associated infection surveillance in Australia

Many hospitals participating in the accreditation system of the Australian Council on Healthcare Standards record health care associated infections, particularly surgical site infections and bloodstream infections. States and Territories are encouraged to establish mechanisms to oversee the development, standardisation, collection and collation of health care associated infection data in their jurisdiction. Such State- and Territory-based systems are currently being developed. The use of standardised surveillance definitions and methods will facilitate the collection of data at a national level. **Appendix 1** provides examples of consensus definitions for surgical site infection and bloodstream infections.

In establishing a national surveillance system, the objectives should be clearly defined. These may include:

- reducing infection rates within health care establishments;
- establishing endemic infection rates;
- identifying outbreaks;
- driving evidence-based changes in clinical practice;
- improving clinical performance in health care establishments; and
- evaluating control measures.

21.3 Outbreak investigation

21.3.1 Outbreak identification

An outbreak may be defined as the occurrence of infections at a rate greater than that expected within a specific geographical area and over a defined period of time. Ideally, surveillance systems should facilitate the early detection of outbreaks. Increasingly, microbiological data are being relied on for this purpose, although outbreaks may be detected using other sources such

² <http://www.health.gov.au/pubhlth/strateg/jetacar/reports.htm>

as pharmacy records. In some instances, the occurrence of an outbreak may be obvious, such as in an episode of food poisoning that affects both HCWs and patients. It is more usual, however, for the outbreak to have an insidious onset that may not be immediately apparent.

The existence of an outbreak should be brought to the attention of the health care establishment's infection control management system and, where necessary, the relevant health authority. An outbreak control team should be formed. As a minimum, this should include:

- a senior representative from the affected clinical service;
- an infection control practitioner (or equivalent); and
- an infectious diseases physician/microbiologist with infection control experience.

Depending on the size and severity of the outbreak, it may be necessary to involve occupational health and safety staff, hospital administrators, engineers and public health officials. One person (often the infection control practitioner; see **Section 8.4**) should be given the responsibility for coordinating the investigation and subsequent control activities. Legislation requires that the relevant public health authority be informed of outbreaks related to notifiable infections. It may also be prudent to involve public health officers at an early stage, if an outbreak is likely to come to the attention of the media.

Hospital and public health (reference) laboratories have an important role in health care associated infection surveillance.

There needs to be adequate laboratory support — if not locally, then from a reference laboratory. It is particularly important to ensure that outbreak isolates are stored for further investigation, because many infectious agents that cause outbreaks in health care establishments are endemic organisms, and it may be necessary to use a typing system to evaluate which isolates are part of any putative outbreak. A simple antimicrobial susceptibility testing may be enough to distinguish isolates, but, against a background of increasing resistance, it may be necessary to use more sophisticated methods of typing, such as randomly amplified polymorphic DNA and pulse field gel electrophoresis. These may be available only from specialised facilities such as reference laboratories, tertiary care hospitals or universities.

21.3.2 Investigation procedures

The principles for investigating outbreaks in health care establishments are the same as for community-based outbreaks. There are three basic steps:

- describing the outbreak;
- developing a hypothesis; and
- testing the hypothesis with analytical epidemiology.

The existence of an outbreak should be brought to the attention of the health care establishment's infection control management system and, where necessary, the relevant health authority.

The tasks involved in any investigation can be summarised as follows:

- Confirm that an outbreak is occurring.
- Determine the background rate of infection, as a temporal cluster of cases may be due to chance alone.
- Confirm the diagnosis using microbiological methods. If possible, confirm that cases are related by typing methods (which may require reference laboratory facilities).
- Define a case, and count cases. Develop a case definition that may include clinical and laboratory data. Start with a broad definition that can be redefined later. In health care establishments, case definition can be relatively easy, with data available through laboratory records and infection control surveillance data. Remember that cases may have been discharged from the establishment.
- Describe the data in terms of time, place and person and construct an epidemic curve. In health care establishments, age, gender and underlying disease are the most useful 'person' attributes to record. The location may suggest risk factors.
- Determine who is at risk of becoming ill.
- Look at changes that may have affected the rate of infection (eg new staff, new procedures, new tests, new units and HCW:patient ratios).
- Develop a hypothesis and test it by comparison with the facts.
- Analytical epidemiology, such as a case-control or retrospective cohort study, can be undertaken quickly to test the hypothesis.
- After interim control measures are in place, a larger, more systematic study may be warranted, possibly with a different analytical methodology.
- Evaluate the data and prepare a written report.
- Implement longer-term infection control measures for the prevention of similar outbreaks.

In the interests of public safety (and because of the threat of litigation), all outbreaks, however minor, should be investigated thoroughly and the outcomes of such investigations documented. All institutions should therefore have adequate resources for the detection and control of outbreaks.

21.4 Outbreak control

Preliminary control measures should be introduced as soon as possible and in association with the local health authority. Heightened surveillance should be introduced to assess the impact of all control measures. As soon as possible, information about the outbreak, the investigation and the results should be conveyed to the committee that deals with infection control issues in the establishment.

All outbreaks provide the opportunity to educate HCWs about infection control matters.

All outbreaks provide the opportunity to educate HCWs about infection control.

21.5 Lookback investigations

'Lookback investigation' refers to the process of identifying, tracing, recalling, counselling and testing patients or HCWs who may have been exposed to an infection in a health care setting.

One example is the case of an HCW who has undertaken exposure-prone procedures on surgical patients and is later found to be positive in a test for hepatitis B virus. If it is determined that the HCW was infectious at the time the exposure-prone procedures were undertaken, the patients with whom he or she had contact could have been infected and would need to be informed of this risk and offered testing and counselling.

Another example is a breakdown in the normal processes of cleaning and disinfection or sterilisation of instruments (such as endoscopes) that may have allowed the transfer of infection from one patient to another.

Lookback investigations are undertaken by blood transfusion services when it has been determined that a person who has donated blood or tissue has subsequently tested positive for a bloodborne virus that was not detected at the time of the donation.

Any type of lookback investigation has the potential to result in a great deal of publicity. This can cause unnecessary anxiety in patients treated at the establishment who have not been exposed to the risk of infection, as well as anger and distress among patients who were put at risk of infection.

As well as provoking publicity and anxiety, lookback investigations can take up a great deal of time and resources and should not be undertaken lightly. The level of infectivity of the affected individual, the type and extent of procedures undertaken and the probable risk to patients need to be carefully considered by those with expertise in these matters. The State/Territory health department should be involved at the outset, and a planning team established with members who have expertise in infection control, microbiology, the discipline involved (surgery, obstetrics etc), public relations, and legal and indemnity issues. Representatives of the management of the health care establishment concerned and the State/Territory health department should also be included.

Lookback investigations require careful planning.

The procedures to be undertaken and how these are presented to patients at risk and the public should be clearly established at the outset. These procedures should also clearly set out protocols for the timely tracing, counselling and referral of potentially exposed individuals. Test results should be made available with minimal delay, and the planning team should ensure that the project is completed and a final report produced as soon as possible.

21.6 Haemovigilance

Haemovigilance is a surveillance system for monitoring and analysing transfusion hazards of blood and plasma products in order to improve the safety of the transfusion process. The term haemovigilance was first used in Europe; over the past few years several countries, including France and the United Kingdom, have established such national surveillance systems for monitoring the adverse effects of transfusions.

In France, there is a compulsory haemovigilance system that collects information from physicians and hospitals on serious and nonserious incidents. The United Kingdom has the voluntary, confidential Serious Hazards of Transfusion Scheme. In 1998, the Australian Red Cross Blood Service established the Haemovigilance Working Party to consider whether haemovigilance plays a role in further improvements in what is universally considered to be a very safe blood supply. At the time of writing these guidelines, the working party had not produced any recommendations for a national haemovigilance scheme.

▷ Infection issues relating to blood and blood products for transfusion are discussed further in **Section 25**.

22 Protection for health care workers

Key points

- ✦ Health care establishments should provide infection protection measures for all health care workers (HCWs). These must include physical protection (personal protective equipment and immunisation), appropriate educational material and programs, effective reporting systems for breaches of protocols, implementation of safe work practices and provision of health screening.
- ✦ All HCWs should be assessed at the start of their employment and offered testing for specific infections before being rostered in high-risk areas. Particular attention should be paid to immune status, skin conditions and pregnancy.
- ✦ Health care establishments should ensure that, where an HCW is known to be particularly susceptible to health care associated infections, the HCW's duties are assessed to ensure that the welfare of patients and other HCWs is safeguarded.
- ✦ HCW vaccination programs should reference the most recent edition of *The Australian Immunisation Handbook* (currently NHMRC 2003).
- ✦ Employers should provide information on the risks associated with pregnancy and should assist pregnant HCWs to avoid infectious circumstances that may present a risk to the HCW (mother) or foetus.

22.1 Introduction

Infection protection for health care workers (HCWs) must be an integral part of the infection control and occupational health and safety programs of any health care establishment (see **Section 8**). HCWs in this context include all HCWs who have the potential for occupational exposure to infectious material. Measures to protect HCWs from infection fall into five categories:

- physical protection
 - personal protective equipment (see **Section 13**)
 - immunisation (see **Section 22.3.3**);
- education;
- reporting systems;
- safe systems of work, design/physical environment and appropriate facilities for infection control; and
- health screening, where appropriate.

Within health care establishments, work practices must be developed and implemented to ensure compliance with infection control standards, appropriate deployment of HCWs and continuing education.

As part of their overall infection control training program, health care establishments must implement specific education on the physical protection and immunisation services provided by the establishment. These programs must emphasise the establishment's policies and the need for compliance. Education should be provided as part of the initial orientation of new HCWs and be reinforced through regular continuing education programs.

A system for reporting breaches of the infection control protocols for the protection of HCWs should form part of the risk management process and be monitored at a senior management level.

Health care establishments must have in place a system for reporting breaches of the infection control protocols for the protection of HCWs. The system should form part of the risk management process for the establishment and should be monitored at a senior management level.

The system must ensure accurate and timely reporting of incidents involving a breach of the infection control protocols as they affect HCWs. In addition, the incident report process should include notes on remedial and follow-up action taken before the process is considered complete.

22.2 Health status of health care workers

Some medical conditions increase HCWs' predisposition to infection if they come into contact with certain infectious patients (eg immune status, some skin conditions). There are many areas within health care establishments where HCWs with these conditions can work safely, and there are few tasks that such HCWs are unable to perform safely. Health care establishments have a responsibility to manage and supervise such HCWs in ways that both acknowledge their right to work and safeguard the welfare of patients and HCWs. This responsibility includes the need to identify such HCWs and inform them of the problems they are likely to encounter in particular circumstances.

22.2.1 Immune status of health care workers

Although other factors may also be involved, substantial depression of immune function predisposes a person to infection. People who are immunosuppressed to this extent would normally be unable to work, but if they are employed as clinical contact workers they are at risk of acquiring health care associated infections. Examples of predisposing conditions include:

- neutropenia (less than 1000 neutrophils per mm³), which is often associated with cancer chemotherapy;
- disseminated malignancy; and
- infection that produces immunodeficiency (eg human immunodeficiency virus, HIV).

22.2.2 Skin conditions (noninfectious)

HCWs with either shedding and/or weeping skin conditions or damaged skin may readily be colonised by health care associated microorganisms. These HCWs may not be harmed by the acquisition of such microorganisms but may disseminate them widely. For example, it is not recommended that such HCWs be placed in wards containing patients with methicillin-resistant staphylococci. These employees should be identified by personal history screening and advised of the problems posed by their condition.

Examples of noninfectious skin conditions include:

- allergic eczema;
- psoriasis; and
- exfoliative dermatitis.

These conditions are not infectious unless they are secondary to an underlying infection.

22.2.3 Pregnancy

Some infectious agents that cause congenital abnormalities are encountered in some hospitals more commonly than in the community.

▷ The precautions recommended in pregnancy are discussed in more detail in **Section 22.4.**

22.3 HCW health screening

Three types of routine screening and assessment of HCWs are proposed:

- routine personal assessment of disease and immune status;
- immunisation; and
- laboratory and other testing.

The diseases that are important for inclusion in each of these procedures are shown in **Table 22.1** and discussed further in **Sections 22.3.1** to **22.3.3**. Consent must be obtained before screening (see **Section 10.7**).

On employment, HCWs should be informed of the health care establishment's health screening policies, and should be counselled about appropriate work placement in accordance with these policies.

On employment, HCWs should be informed of the health care establishment's health screening policies.

Table 22.1 Assessment and immunisation of clinical contact health care workers before employment or rostering

Personal medical history	Immunisation	Laboratory/other testing
Disease Tuberculosis Rubella Measles Mumps Chickenpox (varicella) Herpes simplex Hepatitis B Immune disorders (including medication such as immunosuppressants) Exfoliative and weeping skin conditions ^a	All HCWs should be offered: <ul style="list-style-type: none"> influenza vaccination Td booster^b HCWs who have not been previously immunised or naturally infected should be offered the following vaccinations: <ul style="list-style-type: none"> hepatitis B MMR varicella 	All HCWs in hospitals should routinely be offered pre-employment tuberculin skin test and regular retesting of those who are tuberculin skin test-negative, depending on level of risk. Tuberculin skin test-positive HCWs should be followed up with a chest X-ray and clinical review.
Special circumstances	Special circumstances	Special circumstances
HCWs performing exposure-prone procedures have an ongoing responsibility to know their infectious status for: <ul style="list-style-type: none"> HIV/AIDS hepatitis B hepatitis C 	Some microbiology staff should be immunised against diseases caused by infectious agents with which they work, including: <ul style="list-style-type: none"> Japanese encephalitis hepatitis A meningococcal infection typhoid Q fever plague rabies Australian bat lyssavirus pertussis (using DTPa) 	If there is any doubt about previous infection/immunisation, HCWs should be offered testing for: <ul style="list-style-type: none"> hepatitis A hepatitis B measles^c rubella varicella Pregnant HCWs in exposure situations and those who refuse vaccination should be offered testing for: <ul style="list-style-type: none"> rubella varicella HCWs should undergo test for seroconversion after immunisation against: <ul style="list-style-type: none"> hepatitis B rubella
	HCWs who work in communities with substantial indigenous populations, or custodial carers and carers of the intellectually impaired, should be offered hepatitis A vaccination	After exposure to blood or body fluids contaminated with blood, including needlestick or sharps injuries with a potential for bloodborne virus infections, HCWs should be offered testing for: ^d <ul style="list-style-type: none"> HIV hepatitis C hepatitis B

HCW = health care worker; HIV = human immunodeficiency virus; MMR = measles–mumps–rubella vaccine; Td = adsorbed diphtheria tetanus vaccine — adult formulation

^a For positive exfoliative conditions, ascertain the diagnosis and current treatment.

^b Boosters should be given as recommended in the most recent edition of *The Australian Immunisation Handbook* (NHMRC 2003).

^c If serological testing can be done quickly and cheaply, it may be cost effective to screen HCWs providing direct patient care during a measles outbreak (CDNANZ and MEAC 2000).

^d For further information see **Section 23** and **Appendix 8**.

Note: For further information on immunisation refer to the most recent edition of *The Australian Immunisation Handbook* (currently NHMRC 2003).

22.3.1 Routine assessment of disease and immune status

HCWs should be assessed before they are employed or rostered in specific areas (eg women of childbearing age working in neonatal, oncology or intensive care units, where they may be at risk of exposure to infectious reproductive hazards such as cytomegalovirus). This personal assessment should take the form of an interview (verbal questionnaire). On occasion, serological testing may also be useful. HCWs involved in exposure-prone procedures should know their HIV, hepatitis B virus (HBV) and hepatitis C virus (HCV) status (see **Section 24**). Following substantial exposure to blood or potentially blood-contaminated secretions, HCWs should be offered testing for antibodies to HIV, HBV and HCV (see **Section 23**).

HCWs involved in exposure-prone procedures should know their HIV, HBV and HCV status.

22.3.2 Laboratory testing

All HCWs with patient contact should have a routine tuberculin skin test before starting a new job. Staff working in high-risk areas (eg microbiology laboratory, respiratory ward) should be retested every year if their initial test was negative. Others who initially test negative should be regularly retested and should be retested if they have been exposed to a patient with tuberculosis. The frequency of screening for people who have not had a Bacille Calmette–Guerin (BCG) vaccine should depend on the level of risk.

Routine screening for staphylococcal, streptococcal and salmonella carriers is not recommended. Screening may be instituted if an outbreak or epidemic occurs, and if HCWs are felt to be either at risk or potentially associated with spread of the infection. Carriers of the bacteria involved would not normally transmit infection unless they were excreting bacteria in high numbers (eg from paronychia or chronic sinusitis).

22.3.3 Immunisation

The most recent edition of *The Australian Immunisation Handbook* (currently NHMRC 2003) provides detailed information on immunisation schedules and vaccines. Staff vaccination programs should comply as much as possible with these schedules, which acknowledge that some circumstances may require special consideration before vaccination (eg where an HCW is pregnant). HCWs should therefore be offered the following immunisations:

- Hepatitis A immunisation is recommended for HCWs in paediatric wards, intensive care units and emergency departments that provide for substantial populations of Aboriginal and Torres Strait Islander children, and nursing and medical staff in rural and remote indigenous communities.
- Hepatitis B immunisation is recommended for all staff directly involved in patient care, embalming or the handling of human blood or tissue.
- Rubella immunisation, preferably using measles–mumps–rubella (MMR) vaccine, should be offered to all HCWs born during or since 1986 who are either without immunisation records or seronegative upon screening.

- A booster dose of adult/adolescent formulation diphtheria–tetanus–pertussis (DTPa) vaccine on a single occasion is recommended for HCWs working with young children.
- Chickenpox (varicella) immunisation should be offered to nonimmune HCWs with no history or serological evidence of chickenpox or shingles.
- At the start of their employment, all HCWs should be screened for previous TB exposure by personal medical history or immunisation and should undergo an initial two-step tuberculin skin test. BCG vaccine is of uncertain value, but may be offered to tuberculin skin test-negative HCWs at high risk, or in accordance with State/Territory guidelines (see **Section 29.8.3**).
- Laboratory staff should be immunised against any other pathogenic organisms that they may encounter in their facility, such as Japanese encephalitis virus, hepatitis A virus (HAV), meningococcus, typhoid, Q fever, plague and rabies (see **Table 22.1**).
- Child care staff should also be immunised against HAV, measles, mumps, rubella and varicella–zoster (nonimmune HCWs with no history of chickenpox or shingles).

Health care establishments should have education programs to support their immunisation strategy and reinforce the need for compliance.

Health care establishments should have education programs to support their immunisation strategy and reinforce the need for compliance. Refusal of immunisation by any HCW should be recorded, together with a reason for such refusal, if provided. Further details are given in **Table 22.1**.

22.3.4 Immunisation/health screening records

Health care establishments should develop, maintain and regularly update immunisation/health screening cards and/or records for all HCWs during their employment. These records should be maintained in accordance with the establishment’s policy for the retention of medical records. HCWs should have access to their individual medical screening records on request, and extracts of these screening records should be available to HCWs whenever they change their place of employment.

It is recommended that HCWs maintain their own personal records of all immunisations and screening (see **Section 5.2**).

22.3.5 Infection exposure management

Details of the postexposure prophylactic management required for specific infections are shown in **Table 22.2**.

DISCUSSION POINT



Blood collected but not tested

HCWs who do not wish to undergo testing at the time of exposure may be offered the option to have blood collected and stored but not tested. Blood that is collected and stored for this purpose must be retained for a minimum of 12 months.

Table 22.2 Postexposure prophylaxis and precautions for health care workers

Infectious agent	Recommended tests	Situation in which prophylaxis/precautions are recommended	Prophylaxis/precautions available
Coronavirus	All workers in a SARS team should have their temperatures taken and recorded twice daily. X-ray changes are one of the essential criteria for definition of a case.	Limit non-essential HCW contact with SARS patients. HCWs to avoid direct contact with SARS patient secretions and excretions.	A record should be kept of any reports of unprotected exposure to SARS cases. The management, active/passive surveillance and quarantine depend on the status of the SARS case and should be reviewed on a case-by-case basis by the infection control team (further information available at http://www.health.gov.au/sars.htm)
Cytomegalovirus (CMV)		Particularly for HCWs working in neonatal units, transplant units and caring for HIV-positive patients. For nonimmune pregnant HCWs.	Wash hands after all patient contact and after contact with urine or saliva.
Haemophilus influenza type B virus (HIB)		Not advised	Not advised
Hepatitis A virus (HAV)		For those who have had close contact with a case during the two weeks before, and up to one week after, the onset of jaundice (eg handled faecal waste).	Give NIGH within two weeks of exposure. Hepatitis A vaccine should also be given. If more than 2 weeks has elapsed since exposure, hepatitis A vaccine could be given alone but there is no evidence it will be effective.
Hepatitis B virus (HBV)	HCWs undertaking exposure-prone procedures should know their HBV status. Test source of blood as soon as possible for HBsAg. Test blood of the recipient for antibodies to HBsAg, or store blood for future testing, and then retest at 3 and 6 months if source is positive.	For those who have had significant exposure (percutaneous, ocular or mucous membrane) to blood or potentially blood-contaminated secretions.	Wash site of exposure with soap and water. Flush affected mucous membranes with large volumes of water. If recipient does not have antibodies to hepatitis B (HBsAg), and source is HBsAg-positive or cannot be identified and tested rapidly, give a single dose of HBIG ^a within 48–72 hours and start a course of HBV immunisation at the same time in susceptible HCWs who have not previously been immunised. HBV vaccine should be given within 7 days of exposure, repeated at 1–2 months and at 6 months after the first dose. If the HCW is a known nonresponder to HBV immunisation, HBIG should be given within 72 hours (NHMRC 2003).

Table 22.2 (cont'd) Postexposure prophylaxis and precautions for health care workers

Infectious agent	Recommended tests	Situation in which prophylaxis/precautions are recommended	Prophylaxis/precautions available
Hepatitis C virus (HCV) – interim recommendations pending release of National Hepatitis C Testing Policy.	HCWs undertaking exposure-prone procedures should know their HCV status. Test source of blood as soon as possible for antibodies to HCV. Blood should also be taken from the recipient as soon as possible (baseline sample) and either tested immediately or stored for future testing. If the source is HCV antibody positive, the recipient should be tested at 3 and 6 months, in addition to the baseline test.	For those who have had significant exposure (percutaneous, ocular, or mucous membrane) to blood or potentially blood-contaminated secretions.	Wash site of exposure with soap and water. Flush affected mucous membranes with large volumes of water. No specific PEP for HCV. See Appendix 8 (ANCAHRD Bulletin No 29) for further information.
Human immunodeficiency virus (HIV)	HCWs undertaking exposure-prone procedures should know their HIV status. Test source of blood as soon as possible for antibodies to HIV. If source is HIV positive, gather information on stage of infection, current and previous antiretroviral therapy to decide on appropriate PEP regimen. Test blood of the recipient for antibodies to HIV, or store blood for future testing; retest at 1, 3 and 6 months if source is positive. Follow up to detect any febrile illness occurring within 3 months of exposure.	For those who have had significant exposure (percutaneous, ocular or mucous membrane) to blood or potentially blood-contaminated secretions. For pregnant HCWs, be aware that patient may shed CMV.	Wash site of exposure with soap and water. Flush affected mucous membranes with large volumes of water. If source is HIV positive or cannot be identified and tested rapidly or is at high risk of seroconverting, 2 or 3 antiretroviral drugs (including ZVD or lamivudine) should be administered to recipient within 24–36 hours after exposure ^b (preferably within 2 hours). Continue therapy for 4 weeks. Gloves should be used and hands washed regularly.
Measles virus ^c	Active surveillance for measles among HCWs who may have been exposed during a measles outbreak.	For nonpregnant, nonimmune HCWs. For nonimmune pregnant HCWs and people with underlying immunological disorders.	MMR within 72 hours of exposure or NIGH if 3–7 days after exposure. ^d Ensure nonimmune HCWs are immunised. All exposed non-immune HCWs should be excluded from direct patient contact from 5 days after first exposure to 21 days after last exposure, or until 7 days after rash appears if measles develops (CDC 1998a). NIGH soon after exposure. ^d

Table 22.2 (cont'd) Postexposure prophylaxis and precautions for health care workers

Infectious agent	Recommended tests	Situation in which prophylaxis/precautions are recommended	Prophylaxis/precautions available
<i>Neisseria meningitidis</i> (meningococcus)		Only if HCW engaged in close contact with infected person (eg mouth-to-mouth resuscitation)	Chemoprophylaxis with rifampicin. ^e If unsuitable, use ceftriaxone or ciprofloxacin.
Prion (Creutzfeldt–Jakob disease; CJD)	None available	For those who have contamination of unbroken skin with blood or body fluids, or needlestick injuries and lacerations, from patients with known or suspected CJD. For those who have had ocular exposure to blood or CSF from patients at high risk of CJD.	Wash skin with detergents and large quantities of warm water. Avoid vigorous scrubbing. Immediately institute normal eye washing procedures using warm water.
Rubella virus	Serological follow-up of NIGH recipients for up to 8 weeks.	For pregnant HCWs if nonimmune (ie no previous natural infection or immunisation). ^f All HCWs	NIGH soon after exposure. Ensure nonimmune HCWs are immunised. All exposed non-immune HCWs should be excluded from direct patient contact from 7 days after first exposure until 21 days after the last exposure, or until 5 days after rash appears if rubella develops (CDC 1998a).
<i>Clostridium tetani</i> (tetanus)		For those determined to be at risk of infection depending on circumstances of exposure (eg deep penetrating wound, wound with extensive tissue damage or wound containing foreign bodies).	Clean and disinfect wound. If 5 or more years have elapsed since HCW was last immunised, a booster dose of a tetanus-toxoid-containing vaccine should be administered as soon as possible. Where the recipient has not received 3 or more doses of a tetanus toxoid-containing vaccine or where there is doubt about their tetanus immunisation status, TIG and a tetanus toxoid-containing vaccine should be administered as soon as possible (double TIG dose if more than 24 hours have elapsed since injury).

Table 22.2 (cont'd) Postexposure prophylaxis and precautions for health care workers

Infectious agent	Recommended tests	Situation in which prophylaxis/precautions are recommended	Prophylaxis/precautions available
Varicella–zoster virus (VZV)	Test pregnant HCWs for anti-VZV antibodies.	For pregnant HCWs who are susceptible to varicella infection.	ZIG ^g within 96 hours of exposure. If unavailable, use NIGH. Ensure nonimmune HCWs are immunised.
		All HCWs (with VZV)	All exposed nonimmune HCWs should be excluded from direct patient contact for the duration of the rash

CSF = cerebrospinal fluid; ddI = dideoxyinosine; ddC = dideoxycytidine; HBIG = hepatitis B virus immunoglobulin; HBsAg = hepatitis B virus surface antigen; HCW = health care worker; MMR = measles–mumps–rubella vaccine; NIGH = normal immunoglobulin (human); PCR = polymerase chain reaction; PEP = postexposure prophylaxis; SARS = severe acute respiratory syndrome; TIG = tetanus immunoglobulin; ZDV = zidovudine (also called azidothymidine or AZT); ZIG = high-titre varicella–zoster immunoglobulin

^a Requests for HBIG should be directed to the local State/Territory director of the Australian Red Cross Blood Service.

^b The decision to use antiretroviral PEP should be made promptly, in conjunction with a specialist HIV physician, and with the full consent of the affected person. Doctors should stress to the affected person the importance of strict compliance with the treatment regimen and describe the potential side effects and the appropriate course of action if these are experienced.

^c Further details are given in the *Guidelines for the Control of Measles Outbreaks in Australia* (CDNANZ 2000).

^d Following advice from the local infection control officer, susceptible HCWs who refuse immunisation may be redeployed to duties not requiring direct patient care. Alternatively, until the HCW receives either the MMR vaccine or a dose of NIGH, within the specified time frames, the HCW may be excluded from the facility until 14 days after their last exposure. Furthermore, if a susceptible HCW has not previously received any doses of a measles-containing vaccine they should be offered a second dose of MMR four weeks after the first dose.

^e Rifampicin is not recommended for use in pregnant women. The side-effects of rifampicin should be explained to recipients. Ceftriaxone is potentially safer in pregnancy.

^f NIGH does not prevent rubella infection. It may, however, prolong the incubation period, which may marginally reduce the risk to the foetus and reduce the likelihood of clinical symptoms in the mother.

^g ZIG is available from the local State/Territory Director of the Australian Red Cross Blood Transfusion Service on a restricted basis.

Note: The current edition of *The Australian Immunisation Handbook* (NHMRC 2003) should be consulted for further detail about vaccines and immunoglobulins.

22.4 Pregnant health care workers

Both the employer and a pregnant HCW have an obligation to reduce risks to the foetus. Certain infections can pose a risk to pregnant women and foetuses if acquired during pregnancy. Some of these infections can be acquired in the workplace — for example cytomegalovirus (CMV), hepatitis viruses, HIV, parvovirus, rubella virus and varicella–zoster virus. In general, adherence to standard and additional precautions, vaccination and high standards of general hygiene in the workplace should protect HCWs.

It is the responsibility of pregnant HCWs to advise their medical practitioner and employer of their pregnancy.

Information on the risks associated with pregnancy should be available in the workplace in the form of pamphlets or other information. It is the responsibility of pregnant HCWs to advise their medical practitioner and employer of their pregnancy.

The employer should advise pregnant HCWs of the special risks associated with pregnancy and give them an opportunity to avoid patients with specific infections. All women of childbearing age should be counselled regarding their immune status in relation to varicella and hepatitis B; if necessary, they should be offered immunisation before they become pregnant. All information about the immune status and pregnancy of HCWs must remain confidential: an HCW is only required to provide information about her pregnancy for her own benefit.

All information about the immune status and pregnancy of HCWs must remain confidential: an HCW is only required to provide information about her pregnancy for her own benefit.

The following information relates to infections that are both significant in pregnancy and have some possibility of being acquired through patient care. It is not meant to be a comprehensive account of all infections having relevance to pregnant women. Infections due to herpes simplex virus, *Toxoplasma gondii*, *Treponema pallidum*, *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, *Listeria monocytogenes* and human papilloma virus are not considered, because these are likely to be incidental infections and not acquired through patient contact.

The following information is based on advice given in *The Australian Immunisation Handbook*, the current edition of which (NHMRC 2003) should be consulted for further details.

22.4.1 Rubella

Confirming rubella immunity is part of routine antenatal screening, with consent. However, serious congenital abnormalities associated with rubella most commonly follow infection occurring in the first trimester. For this reason, the rubella antibody status of HCWs should be checked at employment, particularly for women of childbearing age (see **Section 28.13.3**). If rubella antibody is absent or below protective levels, the HCW should be offered vaccination on beginning employment. Rubella vaccination should be avoided in early pregnancy, and conception should be avoided for two months following vaccination, although no case of congenital rubella syndrome has been reported following inadvertent vaccination shortly before or during pregnancy. Where necessary, those vaccinated can be tested for seroconversion two months after vaccination, and revaccinated if necessary.

Postexposure prophylaxis with human normal immunoglobulin (NIGH) will not prevent infection in nonimmune contacts and is therefore of little value for protection of pregnant women exposed to rubella. It may, however, prolong the incubation period, which may marginally reduce the risk to the foetus. It may also reduce the likelihood of clinical symptoms in the mother. NIGH should be used only if termination of pregnancy due to confirmed rubella infection would be unacceptable. In such cases, it should be given soon after exposure. Serological follow-up of recipients is essential, and should continue for up to eight weeks.

► Further details on the occurrence, prevention and management of rubella virus infection are given in **Section 28.13**.

22.4.2 Hepatitis B

Recommended routine HBV screening/testing, immunisation and response to blood and body fluid exposures are described in **Section 28.4.3**. Routine antenatal screening to determine HBV immune status is commonly performed, with the consent of the person being tested.

▷ Further details on the occurrence, prevention and management of HBV infection are given in **Section 28.4**.

While the safety of the HBV vaccine for the developing foetus has not yet been confirmed by a large-scale trial, HBV infection in a pregnant woman may result in severe disease for the newborn. Pregnancy should therefore not be considered a contraindication to administration of HBV immunoglobulin (HBIG) or HBV vaccination.

22.4.3 Cytomegalovirus

CMV is commonly encountered in urine and saliva, but there is little evidence that female HCWs have acquired the virus as a result of patient contact or, in particular, that it has resulted in foetal infection (Lipscomb et al 1984, Murph et al 1998). Routine antenatal screening is not recommended even for HCWs in high-risk areas, but can be offered on an individual basis.

Further details on the occurrence, prevention and management of CMV infection are given in **Section 28.1**.

Pregnant HCWs, or those contemplating pregnancy, should be counselled about the risks of CMV infection, mode of transmission and safe work practices.

22.4.4 Varicella–zoster virus (chickenpox and shingles)

There is some evidence that infection with varicella–zoster virus (VZV) may be more severe in pregnant than in nonpregnant women (Pierre et al 1992, Enders et al 1994, Baren 1996). Fewer than 5% of women of childbearing age do not have immunity to VZV. Even individuals who cannot recall having had chickenpox have an 80% chance of having had VZV. Each establishment should decide whether to test for VZV status, on the basis of risk in the particular setting (not on the basis of potential pregnancy).

If chickenpox occurs during the first 20 weeks of gestation, intrauterine foetal infection and occasionally foetal damage can occur (Enders et al 1994, Lecuru et al 1995). Foetal varicella syndrome is rare (2–3% of affected pregnancies) and clues to its presence may be found at a 20-week ultrasound scan. The most dangerous time to acquire chickenpox during pregnancy is at term or immediately after term (Lecuru et al 1994, 1995). This is because there is a high chance that the newborn infant may be exposed and may have little or no immunity. The newborn may then become seriously ill with VZV infection.

For these reasons, pregnant HCWs who are not immune should not care for patients with chickenpox or shingles. If a female HCW is unsure whether she has had chickenpox, is unsure whether she is pregnant or is contemplating pregnancy, she may have her VZV antibody status checked. VZV vaccine is not recommended during pregnancy, and those who have received the vaccine should not become pregnant for one month after vaccination. If inadvertent exposure occurs, VZV immunoglobulin (ZIG) may be given to the pregnant HCW within 96 hours of exposure to the virus. If ZIG is unavailable, NIGH may be given.

Acyclovir and related agents (eg famivir or valciclovir) are available for the treatment of acute VZV infection. The decision to give a pregnant woman either ZIG or acyclovir is controversial, however, and should be made by a specialist on an individual case basis.

Pregnant HCWs who are not immune should not care for patients with chickenpox or shingles.

▷ Further details on the occurrence, prevention and management of VZV infection are given in **Section 28.14**.

22.4.5 Parvovirus

Parvovirus (B19) infection early in pregnancy may affect the foetus, causing aplastic anaemia that later becomes manifest as midsemester hydrops foetalis. If possible, pregnant HCWs should avoid contact with patients who are infected with human parvovirus. However, this is hard to achieve in practice, apart from avoiding immunosuppressed patients who may experience prolonged shedding of the virus. For other patients, infectivity usually ceases before there is evidence of B19 infection.

▷ Further details on the occurrence, prevention and management of B19 infection are given in **Section 28.10**.

22.5 Tuberculosis

Australia has been particularly fortunate in its low incidence of tuberculosis (TB) (Dawson 1998). As a result, few young HCWs have been exposed to the disease in childhood; as a group, HCWs are particularly vulnerable to infection.

HCWs have varying risks for TB. Those working in TB-risk areas (medical wards, chest clinics, bronchoscopy units, radiology units, TB laboratories, HIV-dedicated wards and autopsy rooms) are at greatest risk of occupational exposure.

However, the prevalence of TB in trainee HCWs is likely to rise as a higher proportion of immigrants from countries in which TB is endemic participate in the workforce. In addition, there has been a worldwide increase in TB, particularly drug-resistant cases, and this may be reflected in an increase of cases amongst HCWs generally.

▷ Details on the occurrence, prevention and management of TB infection are given in **Section 29.8**.

22.6 Laboratory and mortuary staff

Laboratory and mortuary staff should be offered immunisation against the potential infectious hazards they may encounter in their working environment. AS/NZS 2243.3 summarises specific immunisation that should be considered for these workers.¹

¹ AS/NZS 2243.3 1995 *Safety in laboratories, Part 3 — Microbiology*.